SURVEY OF LAKES IN ASSOCIATION WITH THE AVIULLAAVIQ PROSPECT - 2005

Final Report

October 2005

Prepared by:

MJM Research
1012 Shoreland Drive
Lopez Island, WA

Prepared for:

ConocoPhillips Alaska, Inc.
700 G Street
Anchorage, AK

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INTRODUCTION

ConocpPhillips Alasa, Inc. is planning to explore for oil and gas reserves in an area of northwestern NPRA named the Aviullaaviq Prospect, which lies between the Chipp and Ikpikpuk rivers. Exploration includes crossing rivers and lakes with ice roads and withdrawal of water from lakes to support both industrial and domestic needs.

During review of exploration, and potentially development, permits, information is required on the biological sensitivity of lakes in the region. The study was designed to provide physical and biological information on these lakes to understand their use by various fish species. In addition, results of the survey can be used, in concert with previous surveys within the area, to direct any future investigations that may be needed.

Objectives of the study were to document fish presence and habitat use in lakes for lakes that may be used to support exploration activities in association with drilling operations or to support ice road construction between drill sites.

The objectives of the survey were to:

1) obtain lake bathymetry in lakes within the study area that appear suitable for water withdrawal,

2) inventory fish species in lakes within the project study area, and

3) measure water chemistry parameters to assess suitability of water for potential uses.

The 2005 field effort is the first survey of lakes in the northwest region of NPRA since surveys conducted by Netsch et al. (1977) and Bendock and Burr (1985).

Lakes in the area may be needed as sources of freshwater during oil exploration, for ice road and ice pad construction, as well as for short-term potable water supplies. Permitting decisions on water withdrawal will need to consider potential impacts to fish that depend on an adequate water supply for surviving winter. The inventory of fish and fish habitat provides information for assisting permitting decisions regarding water use and ice road routing. Surveys in lakes consisted of short-duration gill net sampling during July 22-24, supplemented with minnow trap sets and visual observations.

Bathymetric and water chemistry data were collected in conjunction with fish sampling. The bathymetric information allows estimating lake volumes. Water chemistry parameters measured include water temperature, specific conductance, dissolved oxygen, pH and turbidity.

METHODS

The biological survey consisted of sampling with gill nets and minnow traps combined with physical measurements from July 22 to 24, 2005. Lakes were sampled with short-duration gill net sets (typically 4 to 6 hours). The gill nets are multimesh, 120 feet long, with six panels of variable mesh, mesh size ranging from 1 to 3.5 inches stretched mesh. These nets have been previously used to collect inventory-level data from lakes throughout the North Slope for similar surveys. Sets were kept to a short duration to minimize the chance for entangling waterfowl and to minimize fish mortality. Since the objective of the gill netting is to document presence/absence, the nets were pulled after fish were detected. Fish captured were measured and released. Duration of each set was recorded to allow calculation of catch rates.

Minnow traps were used to identify smaller fish species that may not be detected by gill nets. Minnow traps baited with preserved salmon eggs were set in pairs at the edge of surveyed lakes. The traps were set and retrieved in concert with the gill net sampling.

Water chemistry parameters were measured to assess habitat conditions and provide information on the suitability of the water for domestic and industrial uses. Water chemistry measurements included surface measures of water temperature, specific conductance, dissolved oxygen, pH, and turbidity. Temperature, specific conductance and dissolved oxygen were *in situ* surface measurements taken along the edge of each lake with a YSI Model 85 meter. A sample was returned to the field office to measure pH and turbidity. PH was measured with an Oaktron Acorn Series pH5 meter. Turbidity was measured with an H.F. Scientific DRT15CE turbidity meter. A water sample was sent to Arctic Fox Environmental for laboratory determination of chloride, sodium, calcium, magnesium, and hardness (as CaCO3).

Bathymetric data were collected to allow estimating lake volume. Location and depth were recorded on a Lowrance Model LCX-15MT integrated GPS/depth sounder. Location and depth were recorded at approximately 1-2 second intervals. The study design was to record at least six to eight depth transects on each lake. Lake volume was estimated by contour mapping of depth intervals. Contour maps were prepared by plotting the position and depth data obtained by GPS on GIS basemaps and plotting the contours in 1 or 2 ft intervals on maps of the surveyed lakes. One foot intervals were plotted for lakes where the maximum depth was 10 ft or less, two foot intervals were used on deeper lakes. The surface area of each contour was obtained, then the volume was estimated using the formula for truncated cones:

$$V = h/3*(A1+A2+(A1*A2)\ (1/2))$$

Where h = vertical depth of the stratum, A1 = area of the upper surface, and A2 = area of the lower surface of the stratum whose volume is to be determined. The volumes of individual strata are summed to obtain the volume of the desired depth intervals.

The amount allowed for winter water withdrawal when sensitive fish species are present is currently

set at 15% of the volume of the lake deeper than 7 feet. When resistant fish species (i.e. ninespine stickleback and Alaska blackfish) are present, the current allocation allowed by Alaska Dept. of Natural Resources is 30% of the volume deeper than 5 feet. There is no withdrawal limit if fish are not present.

The area potentially available for ice aggregate was estimated by calculating the area of the lake shallower than 4 feet, assuming that the ice would grow to at least 4 feet prior to the need for aggregate. If the ice is shallower than 4 feet at the time of ice removal, then the area available will be less.

Lake Summaries

This report uses lake numbering based a researcher/year code. The lake number contains several pieces of information, including the code of the sampler and the year of sampling.

Sampler Code:

MC = McElderry and Craig (1981); sampling in 1979
B = Bendock sampling from 1977-1986
L = Lobdell; water chemistry sampling in 1991-1999
M = Moulton; fish sampling in 1995-2005
MB = Michael Baker Jr., Inc. water chemistry sampling in 2002-2004
N = Netsch et al. (1977) NPRA sampling in 1977
R = Reanier sampling in 2000-2005

First Two Numerals:

Year of Initial Sampling
(if Moulton sampled a lake previously sampled by McElderry and Craig, then the McElderry and Craig lake number is used)

Last Two Numerals:

Numbers from 1 to 99 used to identify the individual lake sampled within a given year

Information contained for each surveyed lake (if measured) includes:

1. A diagram of the lake,
2. Other names utilized for the same lake,
3. Lake location, in latitude/longitude,
4. The USGS quadrangle sheet and the township and range in which the lake is situated
5. Surface area in acres, obtained from USGS digital maps,
6. Maximum depth in feet,
7. Presence or absence of an outlet,
8. Calculated total lake volume
9. Water volume under 4 feet of ice,
10. Water volume under 5 feet of ice
11. Water volume under 7 feet of ice

12. Acres of potential ice aggregate for road construction,
13. Maximum recommended winter water withdrawal, exclusive of volumes related to ice aggregate,
14. Water chemistry measurements,
15. Catch record, including gear used, date sampled, species caught and size range,
16. Where appropriate data exist, the length frequency of dominant species is plotted,
17. Map of potential ice aggregate removal areas, and
18. Map showing measured depth transects.

RESULTS AND DISCUSSION

Biological Observations

A total of 10 lakes were sampled in 2005 in connection with potential exploration activities in the Aviullaaviq study region (Table 1, Figure 2). Nine of the 10 lakes contained fish species sensitive to habitat changes likely to be associated with winter water withdrawal. One lake (M0532) did not yield fish during the sampling period. These results are consistent with previous sampling in nearby areas, where most lakes associated with the Ikpikpuk/Chipp river drainage system support fish if the lakes are deep enough and are seasonally connected to the streams (Netsch et al. 1977, Bendock and Burr 1985).

Water Chemistry Measurements

Water chemistry parameters measured in the studied lakes are presented Table 3. Surface water temperature during the July 22-24 sampling in 2005 averaged 10.9^{o}C, ranging from 9.0 to 12.7^{o}C. As expected for natural surface waters, dissolved oxygen was high, averaging around 11.0 mg/l. Specific conductance ranged from 51 to 247 microSiemens/cm, while pH was between 7.20 to 8.14.

Evaluation of Fish Concerns

Information from fish sampling and depth measurements was used to evaluate each lake regarding its potential to support fish. Obviously, if fish were captured during gill net sampling, the lake was classified as fish-bearing. Gill net sets were relatively short, however, so absence of catch does not necessarily mean a lake does not support fish. Lakes also were assessed for their proximity to fish-bearing streams and their depth. Lakes deeper than 7 feet are likely to retain unfrozen water during winter, thus have potential to overwinter fish. Deep lakes that are near fish-bearing streams and are likely to have a connection with the stream at some point during the year are classified as potential fish-bearing lakes, with additional sampling needed if further clarification of the designation is desired. Results of the evaluation are included in Table 4.

Lakes in which fish were verified as present are divided into those lakes containing species sensitive

to habitat changes likely to be associated with water withdrawal and those containing species more resistant to such changes. Species sensitive to impacts of water withdrawal (such as reduced dissolved oxygen and increased dissolved solids) include lake trout, broad whitefish, least cisco and arctic grayling, while the more resistant species are Alaska blackfish and ninespine stickleback. Alaska blackfish are particularly resistant to low dissolved oxygen, being able to breathe atmospheric oxygen (Armstrong 1994). Residents of the Yukon Delta have reported observing Alaska blackfish oriented along cracks in the ice during winter to use oxygen in ponds that have gone anoxic. Ninespine stickleback can also withstand low dissolved oxygen (Lewis et al. 1972), although not the same extent as Alaska blackfish. Ninespine stickleback, however, can withstand higher levels of dissolved solids, and often frequent brackish nearshore waters during summer.

When sensitive fish are present, the amount of water available during winter is limited to 15% of the volume under 7 feet of ice. The water withdrawal criteria are relaxed when only resistant fish species are present because of the greater tolerance to lower dissolved oxygen and higher concentrations of dissolved solids. In this case, up to 30% of the water volume under 5 feet of ice is allowed for winter withdrawal. For lakes that do not contain fish, there is currently no limit to the amount taken. For practical reasons, the volume available is limited to the volume of unfrozen water under the ice at the time of withdrawal. In most cases, the withdrawal occurs when the ice is 4 feet thick or greater. In order to provide some estimate of water likely to be available, the volume of water under 4 feet of ice is provided.

Based on the above lake evaluation, 9 of the 10 lakes were confirmed to contain sensitive fish species, while one was considered to be devoid of fish.

Based on the above analysis, 91.2 million gallons of water are likely to be available for under-ice withdrawal during winter from lakes surveyed during 2005 in association with the Aviullaaviq prospect. This estimate does not include volumes associated with ice aggregate removal.

The area covered by water less than 4 feet deep, and therefore likely to be suitable for removing ice aggregate, was estimated for each lake (Table 5). A map of the potential ice aggregate area for each lake is included in the individual lake summaries. Based on the above analysis, 325 acres are likely to be available for ice chips from lakes surveyed during 2005 in association with the Aviullaaviq prospect.

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Table 1. Summary of lakes sampled in or near Aviullaaviq prospects in 2005.

Lake Name	Latitude (NAD83)	Longitude (NAD83)	Town	Range	Section	Surface Area (acres)	Maximum Depth (feet)	Lake Volume (mill. gals)
B84140	N70.59087	W155.08798	14N	12W	6/7	357.8	16.0	868.27
M0517	N70.59649	W155.18466	14/15N	13W	2/3/34	265.1	21.9	563.98
M0526	N70.55986	W155.10590	14N	12/13W	18/19/13/24	104.8	20.0	205.97
M0527	N70.56064	W155.12884	14N	13W	13/24	99.7	11.9	120.61
M0528	N70.56632	W155.11842	14N	12/13W	18/13	138.0	16.3	250.73
M0529	N70.57044	W155.13927	14N	13W	13	60.7	12.3	91.87
M0530	N70.55891	W155.16475	14N	13W	14/23	36.3	20.1	147.51
M0531	N70.57508	W155.17494	14N	13W	11/14	72.8	11.7	128.83
M0532	N70.58892	W155.23266	14N	13W	3/4/9/10	51.8	13.1	58.03
M0533	N70.59798	W155.23240	14N	13W	3/4	61.9	14.8	176.23

Table 2. Catches of fish from lakes sampled in or near Aviullaaviq prospects in 2005.

		Gill Nets		Minnow Traps	
Lake Name	Sample Date	Set Duration (hours)	Fish Species[1]	Set Duration (hours)	Fish Species[2]
B84140	Jul 22 05	5.8	BDWF, LSCS	33.1	NSSB
B84140	1984[3]	~24	LSCS	0.0	--
M0517	Jul 23 05	2.5	LSCS, BURB	6.9	NSSB
M0526	Jul 23 05	2.1	BDWF	2.4	NSSB
M0527	Jul 23 05	7.3	LSCS	4.7	NSSB
M0528	Jul 23 05	connected to M0526 and M0527, not fished			
M0529	Jul 24 05	0.7	LSCS	0.0	--
M0530	Jul 24 05	0.7	LSCS	0.0	--
M0531	Jul 24 05	6.0	LSCS	67.3	NSSB
M0532	Jul 24 05	4.1	none	17.4	none
M0533	Jul 23 05	1.6	BDWF, LSCS	7.6	NSSB,BKFH

[1] BDWF = broad whitefish, LSCS = least cisco, BURB = burbot

[2] NSSB = ninespine stickleback, BKFH = Alaska blackfish

[3] sampled in 1984 by Bendock and Burr

Table 3. Water chemistry parameters measured in conjunction with lake sampling in or near Aviullaaviq prospects in 2005.

Lake	Date	Water Temp (°C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)
B84140	Jul 22 05	9.0	11.6	51	2.1	7.21	8.3	1.4	<3.0	1.5	26
M0517	Jul 23 05	12.7	10.7	78	0.7	7.51	12.0	2.1	<3.0	2.9	39
M0526	Jul 23 05	9.5	11.1	214	0.5	8.14	33.0	6.1	5.2	11.7	110
M0527	Jul 23 05	10.3	10.8	130	0.8	7.20	19.0	3.7	3.0	6.2	63
M0528	Jul 23 05	10.2	10.8	80	1.3	7.39	12.0	2.2	<3.0	3.0	39
M0529	Jul 24 05	12.2	10.6	80	0.7	8.01	12.0	2.2	<3.0	2.4	39
M0530	Jul 24 05	10.7	11.4	223	0.7	7.98	36.0	6.3	3.7	7.8	120
M0531	Jul 23 05	12.1	10.7	154	0.5	7.45	22.0	4.6	3.9	7.5	74
M0532	Jul 24 05	11.1	10.9	247	0.4	7.76	33.0	9.6	5.8	14.2	120
M0533	Jul 23 05	11.2	11.0	111	1.0	7.38	17.0	3.1	<3.0	4.3	55

Table 4. Recommended maximum water volumes available for winter water withdrawal from surveyed lakes in or near Aviullaaviq prospects in 2005 (does not include volume related to ice aggregate).

(requested water based on 15% of winter volume deeper than 7 ft when sensitive species are present, 30% of winter volume deeper than 5 ft when resistant or no fish are likely to be present).

Lake	Surface Area (acres)	Max. Depth (feet)	Calculated Volume (mil. gals)	Volume Under 4ft of Ice (mil. gals)	30% of 5 ft Winter Volume (mil. gals)	15% of 7 ft Winter Volume (mil. gals)	Sensitive Fish Species Present[1]	Resistant Fish Species Present[2]	Maximum Winter Withdrawal (mil. gals)
B84140	357.8	16.0	868.27	454.45	108.51	28.56	BDWF, LSCS	NSSB	28.56
M0517	265.1	21.9	563.98	272.98	64.11	17.76	LSCS, BURB	NSSB	17.76
M0526	104.8	20.0	205.97	90.32	19.85	3.99	BDWF, LSCS	NSSB	3.99
M0527	99.7	11.9	120.61	49.90	8.69	1.31	BDWF, LSCS	NSSB	1.31
M0528	138.0	16.3	250.73	94.32	18.36	1.65	BDWF, LSCS	NSSB	1.65
M0529	60.7	12.3	91.87	35.69	7.66	1.30	LSCS	--	1.30
M0530	36.3	20.1	147.51	102.59	27.60	10.74	LSCS	--	10.74
M0531	72.8	11.7	128.83	53.49	11.63	2.27	LSCS	NSSB	2.27
M0532	51.8	13.1	58.03	15.22	3.22	0.66	none	none	15.22
M0533	61.9	14.8	176.23	103.64	26.14	8.42	BDWF, LSCS	NSSB,BKFH	8.42

[1] Sensitive species include grayling, whitefishes, char, burbot, slimy sculpin, etc.
BDWF = broad whitefish LSCS = least cisco BURB = burbot

[2] Resistant species are Alaska blackfish (BKFH) and ninespine stickleback (NSSB)

-- = not sampled

Table 5. Estimated area available for removing ice aggregate, based on the area covered by water shallower than 4 feet, in or near Aviullaaviq prospects in 2005.

Lake	Surface Area (acres)	Max. Depth (feet)	Acres covered by Water shallower than 4 feet
B84140	357.8	16.0	66.6
M0517	265.1	21.9	72.4
M0526	104.8	20.0	27.2
M0527	99.7	11.9	22.6
M0528	138.0	16.3	31.9
M0529	60.7	12.3	28.2
M0530	36.3	20.1	3.3
M0531	72.8	11.7	25.5
M0532	51.8	13.1	36.6
M0533	61.9	14.8	10.3

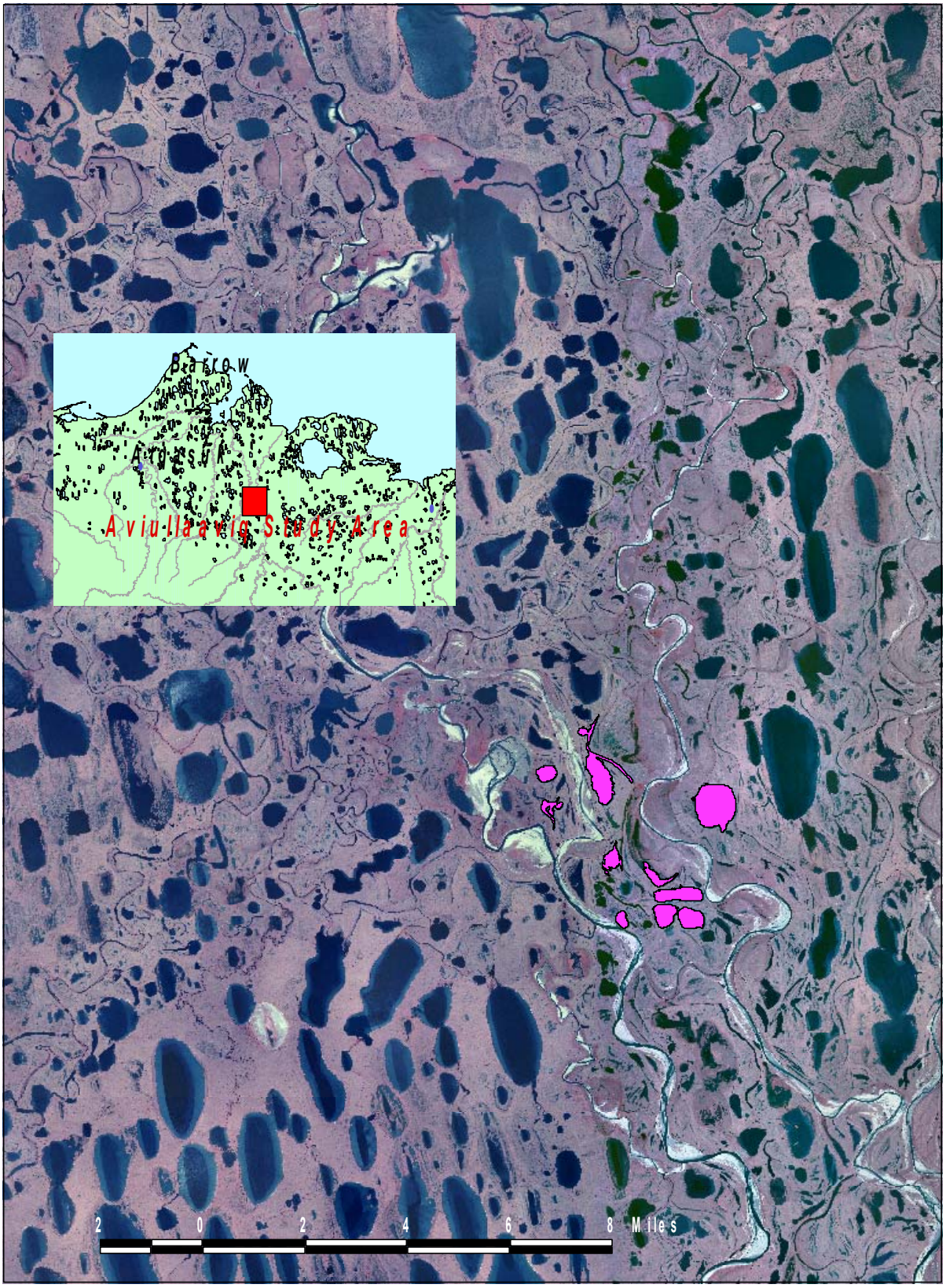


Figure 1. Aviullaaviq Prospect study area of northwestern NPRA, showing location of lakes sampled in summer 2005 for potential use during exploration.

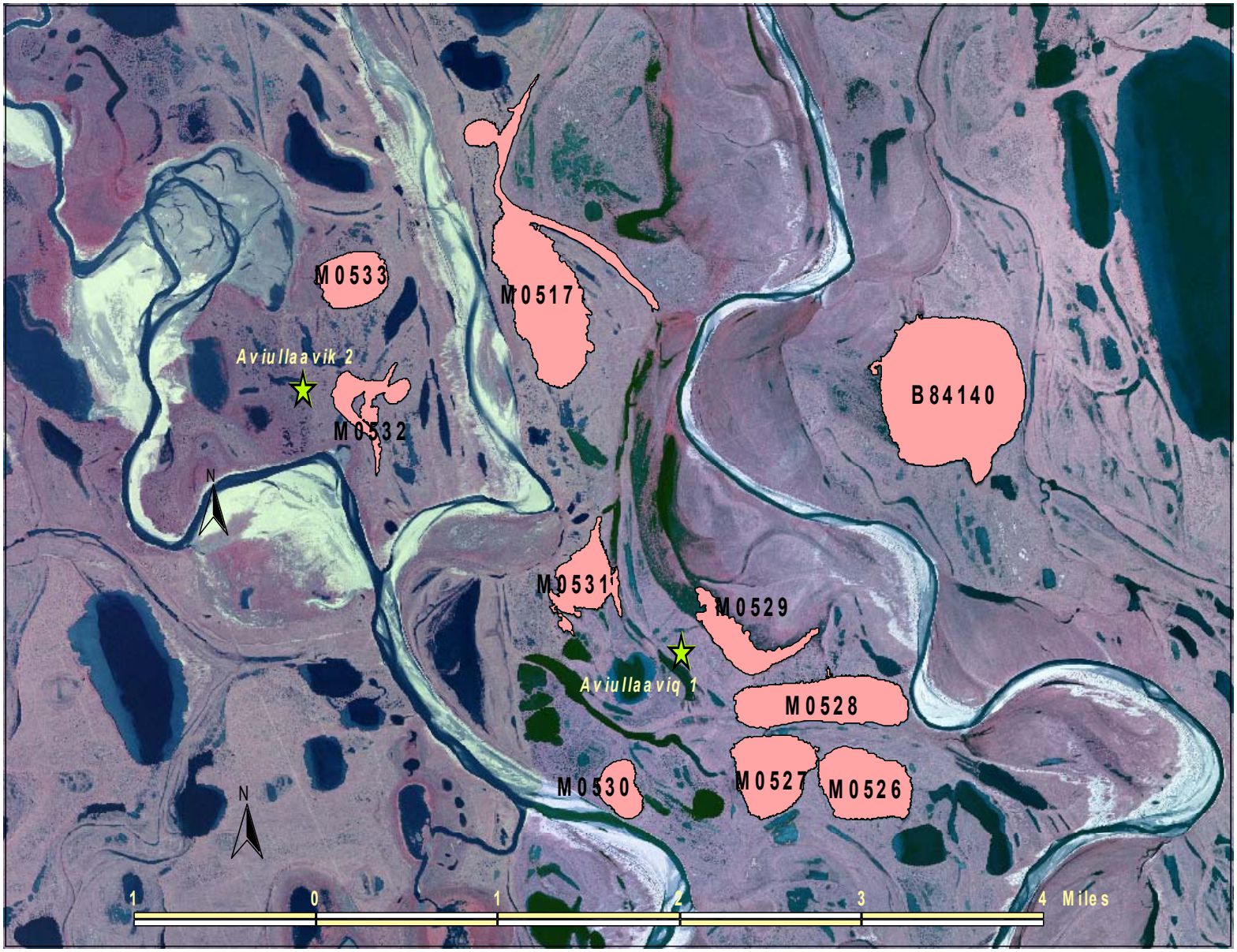


Figure 2. Lakes surveyed in the Aviullaaviq study area during summer 2005 for potential use during exploration.

Lake Summaries

Lake B84140

Other Names: None Known
Location: 70.59087°N 155.08798°W
USGS Quad Sheet: Teshekpuk C-4: T14N R12W Sec. 6/7
Area: 357.8 acres
Maximum Depth: 16.0 feet
Active Outlet: Yes
Total Lake Volume: 868.3 million gallons (July 22, 2005 data)
Water Volume Under 4 ft of ice: 454.4 million gallons
Water Volume Under 5 ft of ice: 361.7 million gallons
Water Volume Under 7 ft of ice: 190.4 million gallons
Potential Ice Aggregate: 66.6 acres (water depth 4 ft or less)

Maximum Recommended Winter Removal: **28.56 million gallons**
(15% of water volume under 7 ft of ice)
(does not include volumes related to ice chips)

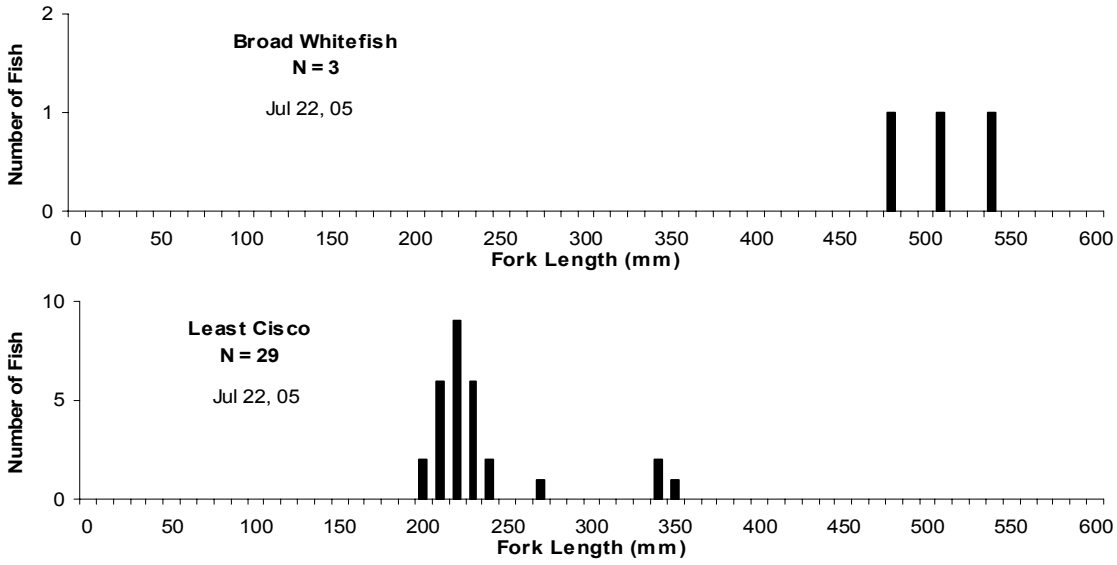
Water Chemistry:

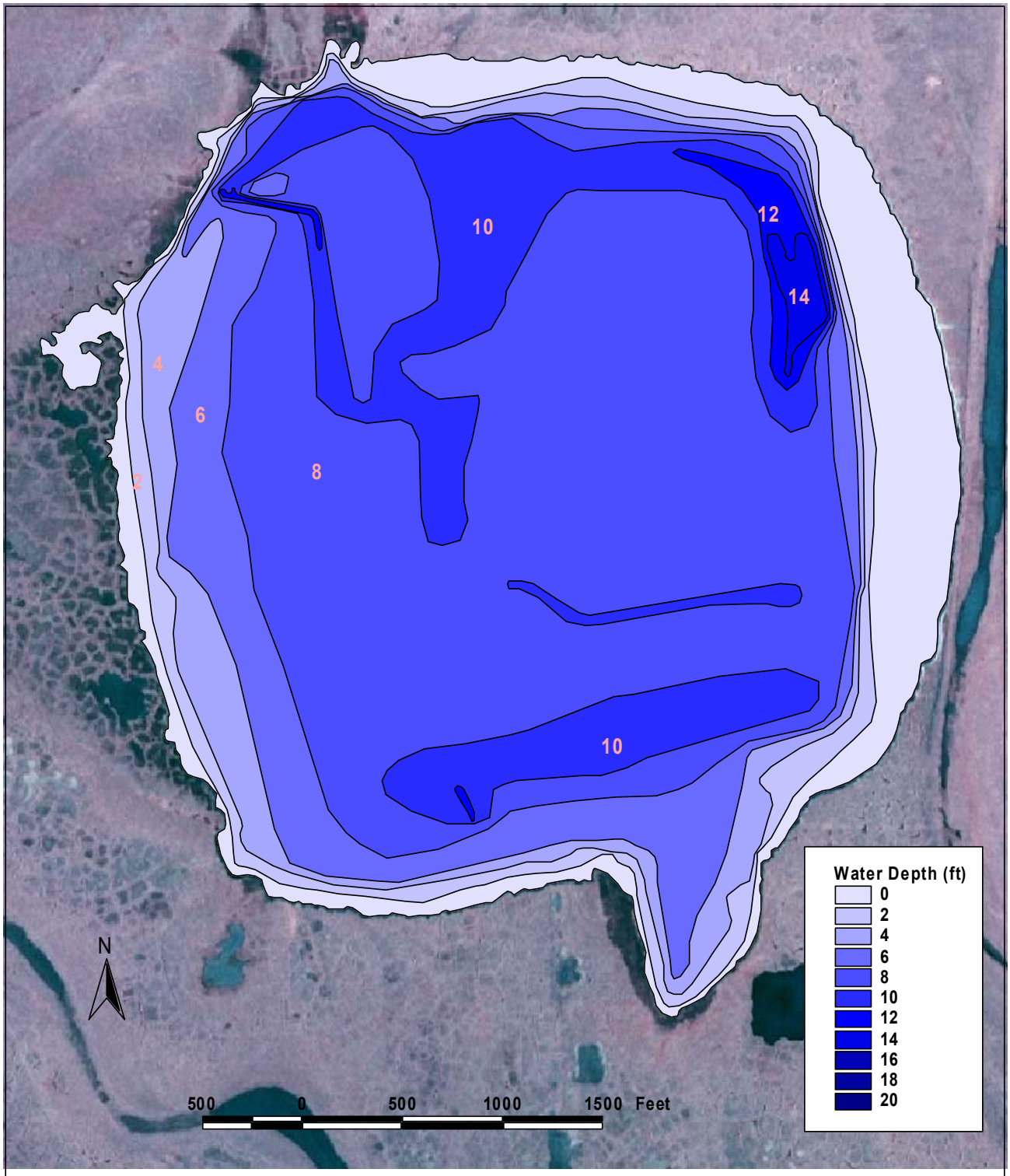
Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2005	8.3	1.4	1.5	<3	26	51	2.1	7.21	This Study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	1984[1]	~24	Least cisco		
Gill Net	Jul 22 05	5.8	Broad whitefish	3	480-545
			Least cisco	29	205-355
Minnow Trap	Jul 22 05	33.1	Ninespine stickleback	1	

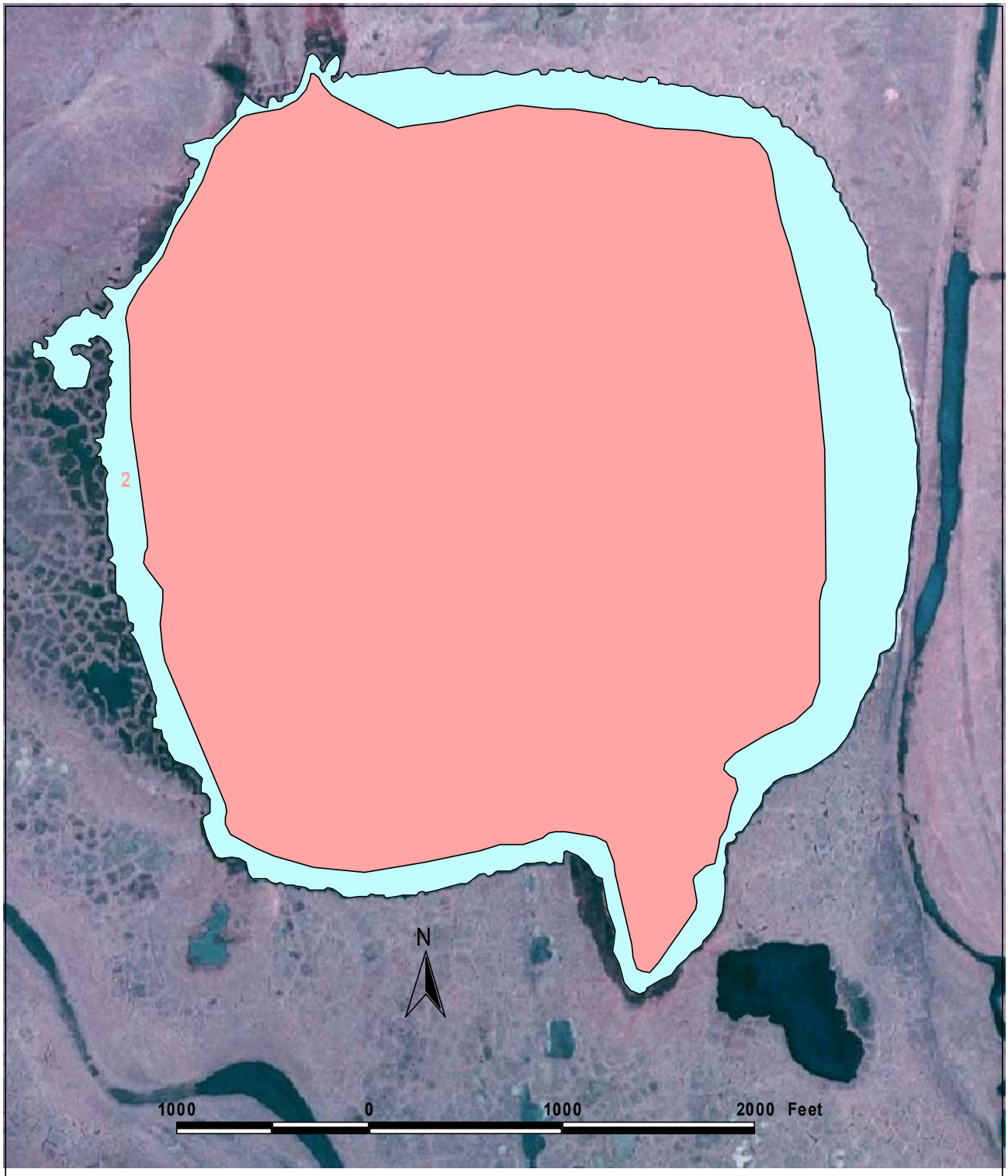
[1] Bendock and Burr (1985)





Depth contours of lake B84140 based on transects surveyed on July 22, 2005
(depths in 2 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)



Regions of lake B84140 less than 4 feet deep (light-shaded) and likely to available for ice chips, based on transects surveyed on July 22, 2005.

(not to be used for navigation or to direct use of heavy equipment)

Depth transects surveyed at lake B84140 on July 22, 2005.

Lake M0517

Other Names: Field identifier - CP0510
Location: 70.59649°N 155.18466°W
USGS Quad Sheet: Teshekpuk C-4: T14/15N R13W Sec. 2/3/34
Area: 265.1 acres
Maximum Depth: 21.9 feet
Active Outlet: Yes
Total Lake Volume: 564.0 million gallons (July 23, 2005 data)
Water Volume Under 4 ft of ice: 273.0 million gallons
Water Volume Under 5 ft of ice: 213.7 million gallons
Water Volume Under 7 ft of ice: 118.4 million gallons
Potential Ice Aggregate: 72.4 acres (water depth 4 ft or less)

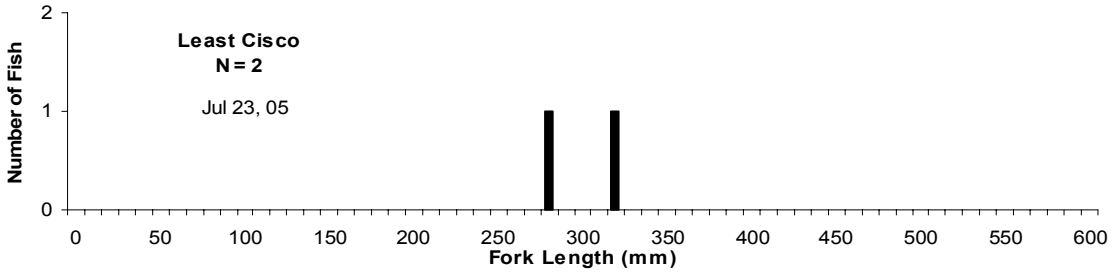
Maximum Recommended Winter Removal: **17.76 million gallons**
(15% of water volume under 7 ft of ice)
(does not include volumes related to ice chips)

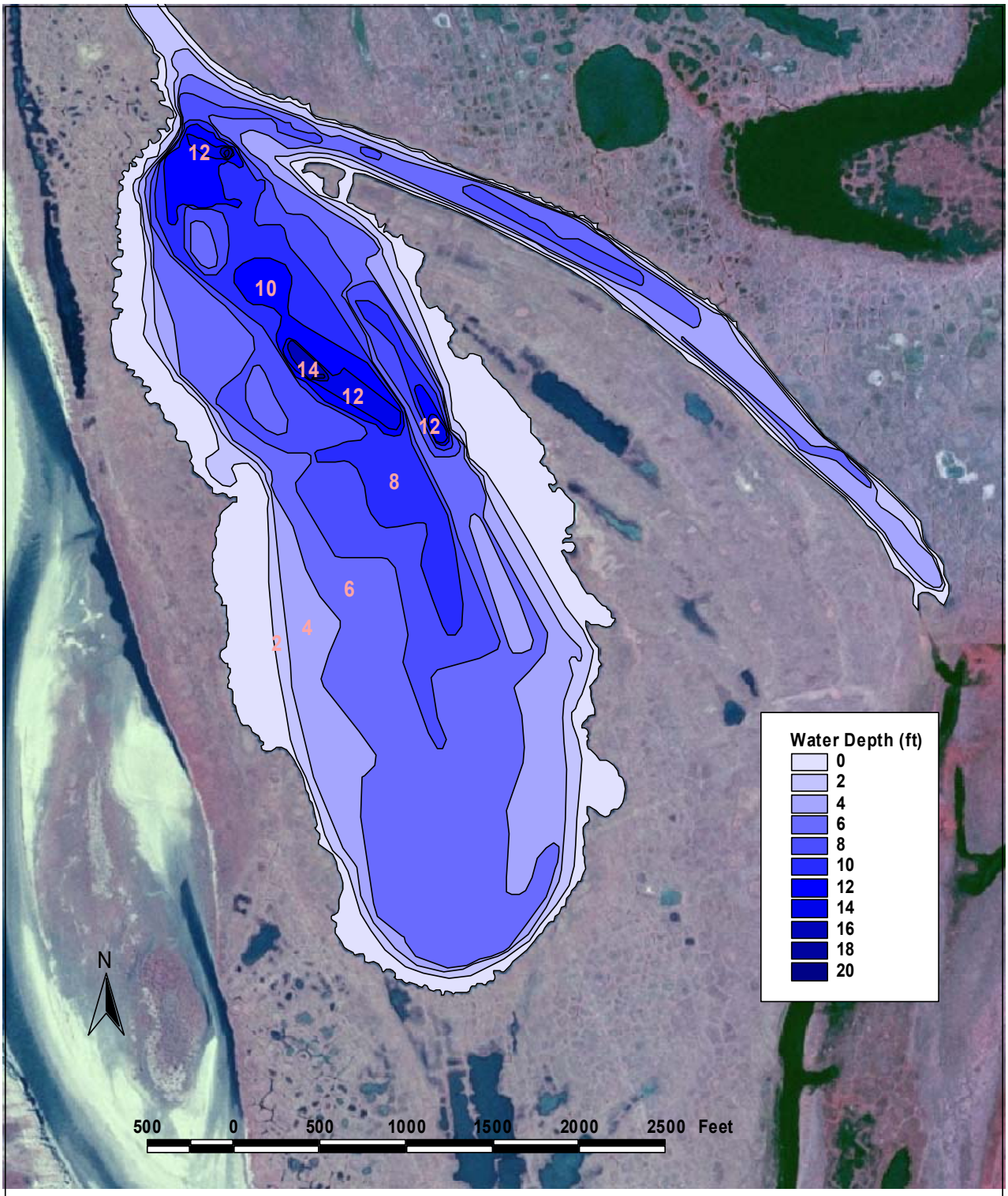
Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2005	12.0	2.1	2.9	<3	39	78	0.7	7.51	This Study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 23 05	2.5	Least cisco	2	288, 325
			Burbot	1	670
Minnow traps	Jul 23 05	6.9	Ninespine stickleback	1	





Depth contours of lake M0517 based on transects surveyed on July 23, 2005
(depths in 2 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Regions of lake M0517 less than 4 feet deep (light-shaded) and likely to available for ice chips, based on transects surveyed on July 23, 2005.

(not to be used for navigation or to direct use of heavy equipment)

Depth transects surveyed at lake M0517 on July 23, 2005.

Lake M0526

Other Names: Field identifier - CP0509
Location: 70.55986°N 155.10590°W
USGS Quad Sheet: Teshekpuk C-4: T14N R12/13W, Sec. 18/19/13/24
Area: 104.8 acres
Maximum Depth: 20.0 feet
Active Outlet: Yes
Total Lake Volume: 206.0 million gallons (July 23, 2005 data)
Water Volume Under 4 ft of ice: 90.3 million gallons
Water Volume Under 5 ft of ice: 66.2 million gallons
Water Volume Under 7 ft of ice: 26.6 million gallons
Potential Ice Aggregate: 27.2 acres (water depth 4 ft or less)

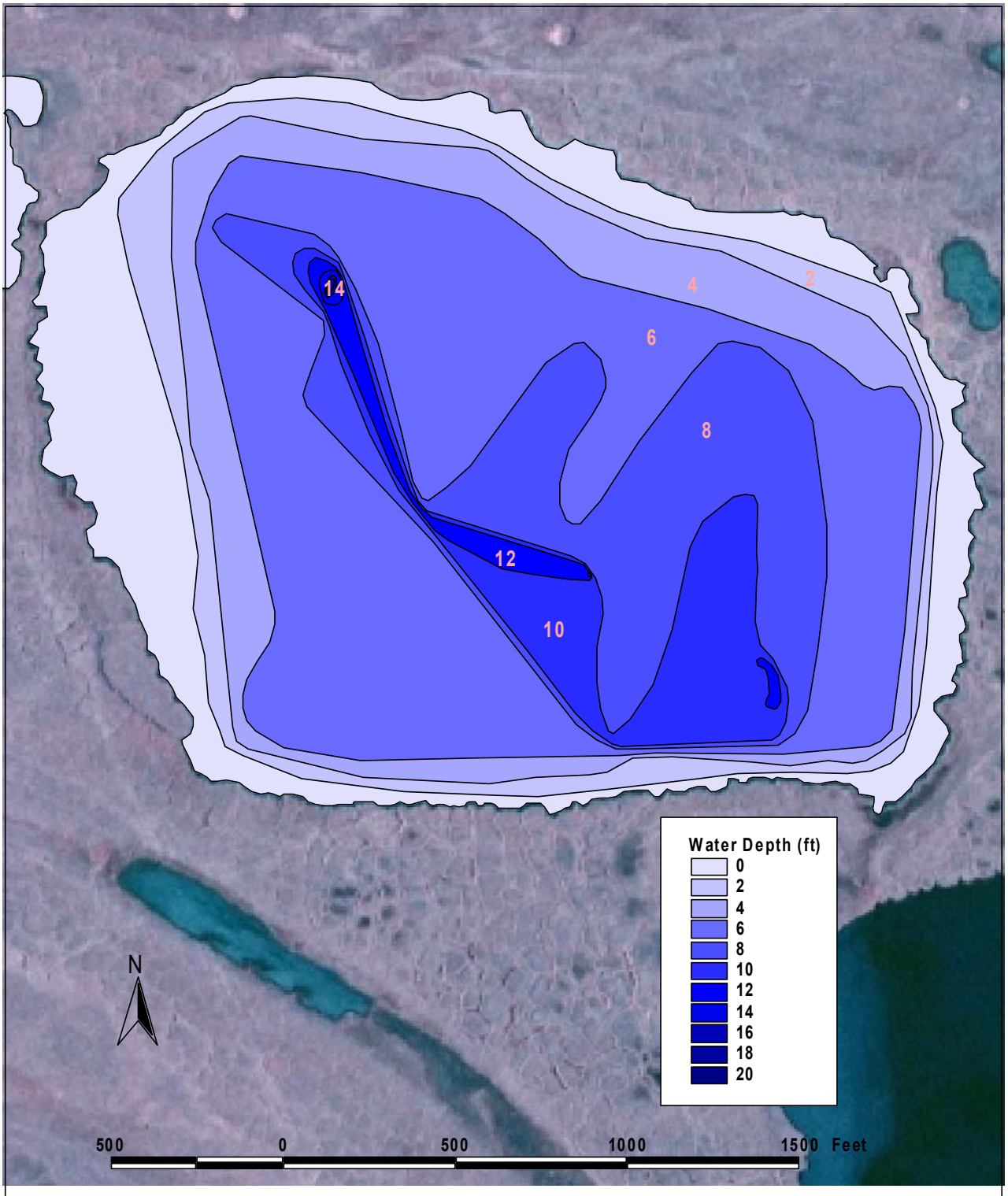
Maximum Recommended Winter Removal: **3.99 million gallons**
(15% of water volume under 7 ft of ice)
(does not include volumes related to ice chips)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2005	33.0	6.1	11.7	5.2	110	214	0.5	8.14	This Study

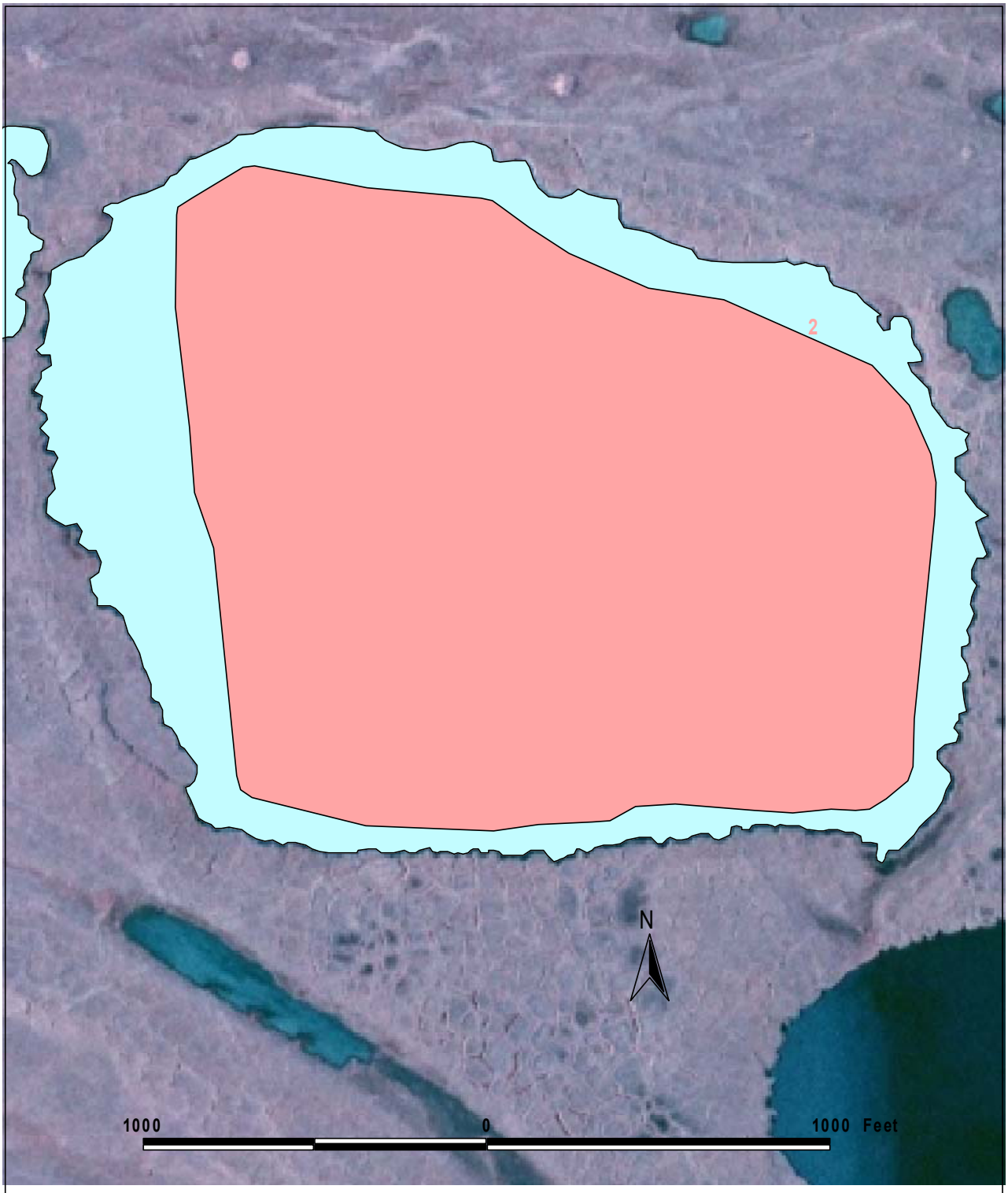
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 23 05	2.1	Broad whitefish	1	escaped
Minnow traps	Jul 23 05	2.4	None	0	



Depth contours of lake M0526 based on transects surveyed on July 22, 2005
(depths in 2 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)



Regions of lake M0526 less than 4 feet deep (light-shaded) and likely to available for ice chips, based on transects surveyed on July 22, 2005.

(not to be used for navigation or to direct use of heavy equipment)

Depth transects surveyed at lake M0526 on July 22, 2005.

Lake M0527

Other Names: Field identifier - CP0508
Location: 70.56064°N 155.12884°W
USGS Quad Sheet: Teshekpuk C-4: T14N R13W, Sec. 13/24
Area: 99.7 acres
Maximum Depth: 11.9 feet
Active Outlet: Yes
Total Lake Volume: 120.6 million gallons (July 23, 2005 data)
Water Volume Under 4 ft of ice: 49.9 million gallons
Water Volume Under 5 ft of ice: 29.0 million gallons
Water Volume Under 7 ft of ice: 8.7 million gallons
Potential Ice Aggregate: 22.6 acres (water depth 4 ft or less)

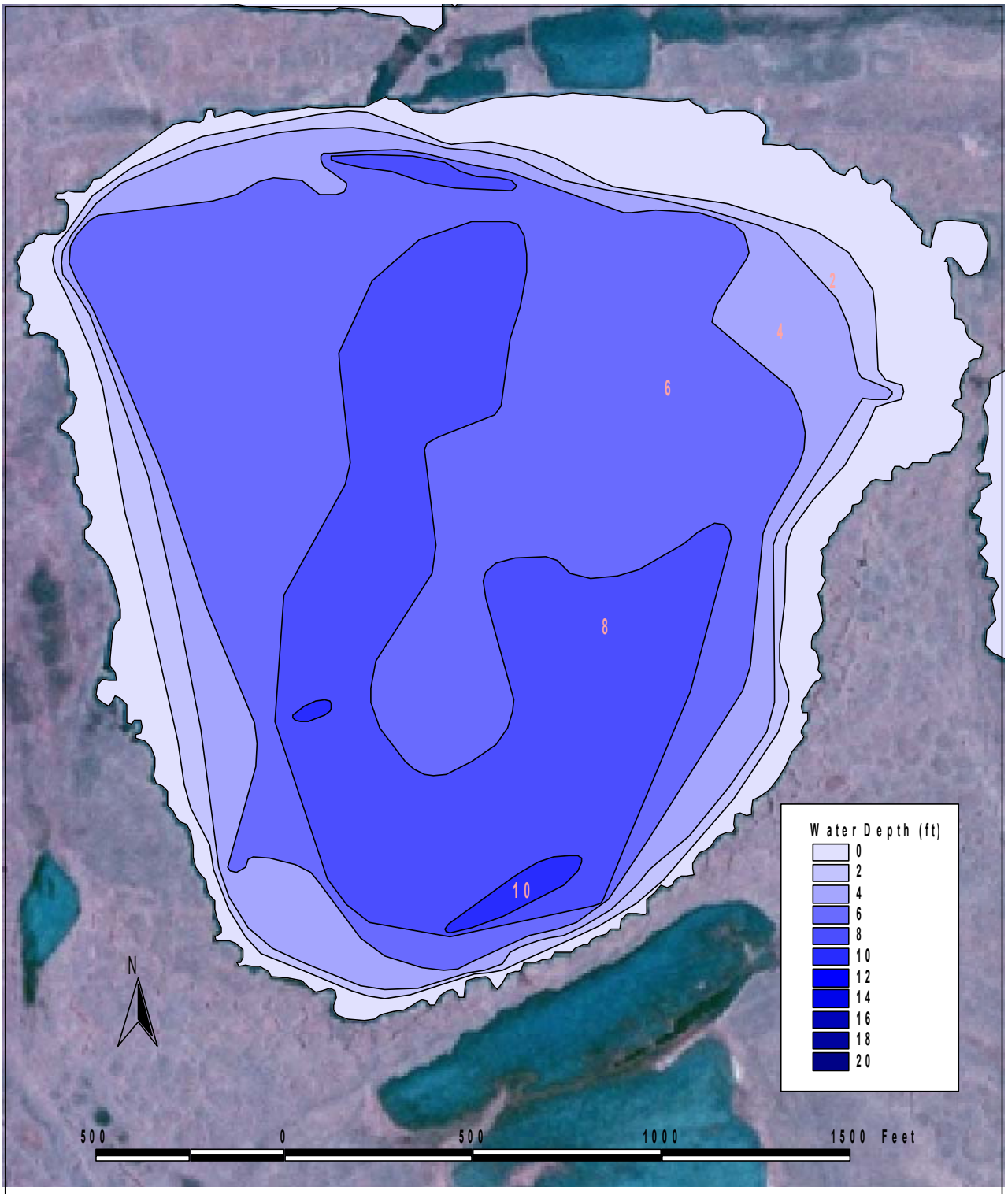
Maximum Recommended Winter Removal: **1.31 million gallons**
(15% of water volume under 7 ft of ice)
(does not include volumes related to ice chips)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2005	19.0	3.7	6.2	3.0	63	130	0.8	7.20	This Study

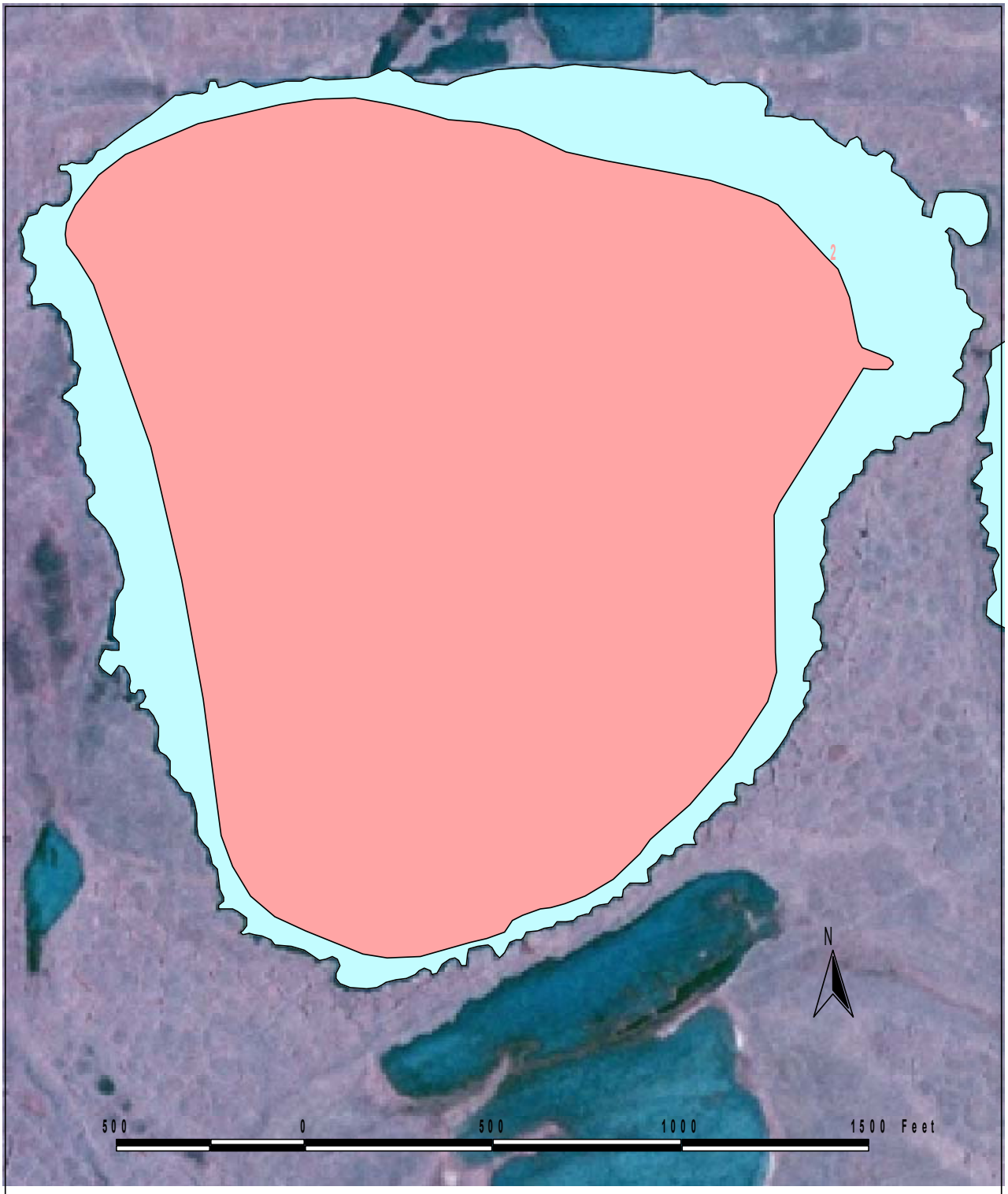
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 23 05	7.3	Least cisco	1	260
Minnow traps	Jul 23 05	4.7	Ninespine stickleback	16	



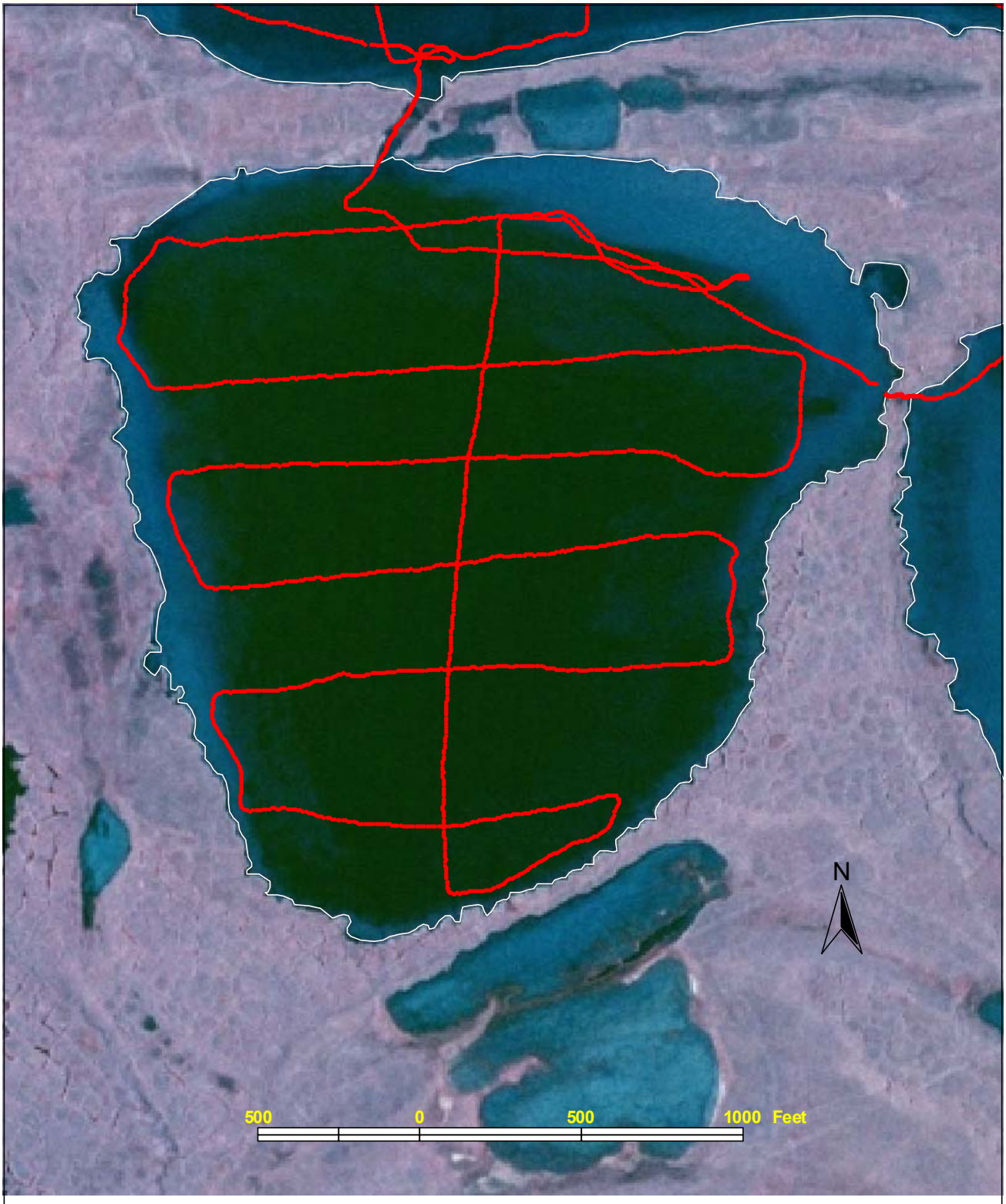
Depth contours of lake M0527 based on transects surveyed on July 23, 2005
(depths in 2 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)



Regions of lake M0527 less than 4 feet deep (light-shaded) and likely to available for ice chips, based on transects surveyed on July 23, 2005.

(not to be used for navigation or to direct use of heavy equipment)



Depth transects surveyed at lake M0527 on July 23, 2005.

Lake M0528

Other Names: Field identifier - CP0507
Location: 70.56632°N 155.11842°W
USGS Quad Sheet: Teshekpuk C-4: T14N R12/13W, Sec. 18/13
Area: 138.0 acres
Maximum Depth: 16.3 feet
Active Outlet: Yes
Total Lake Volume: 250.7 million gallons (July 23, 2005 data)
Water Volume Under 4 ft of ice: 94.3 million gallons
Water Volume Under 5 ft of ice: 61.2 million gallons
Water Volume Under 7 ft of ice: 11.0 million gallons
Potential Ice Aggregate: 31.9 acres (water depth 4 ft or less)

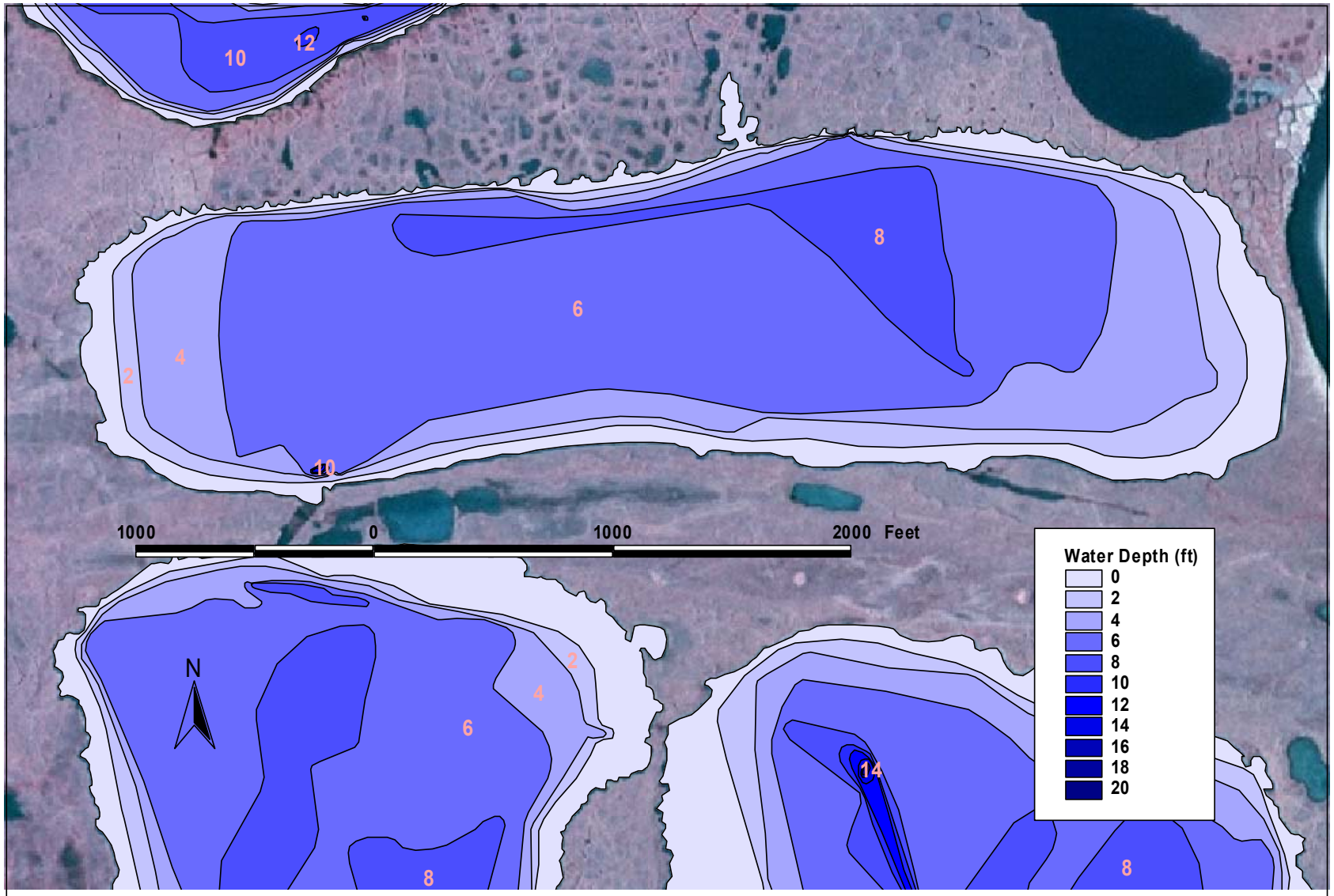
Maximum Recommended Winter Removal: **1.65 million gallons**
(15% of water volume under 7 ft of ice)
(does not include volumes related to ice chips)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2005	12.0	2.2	3.0	<3	39	80	1.3	7.39	This Study

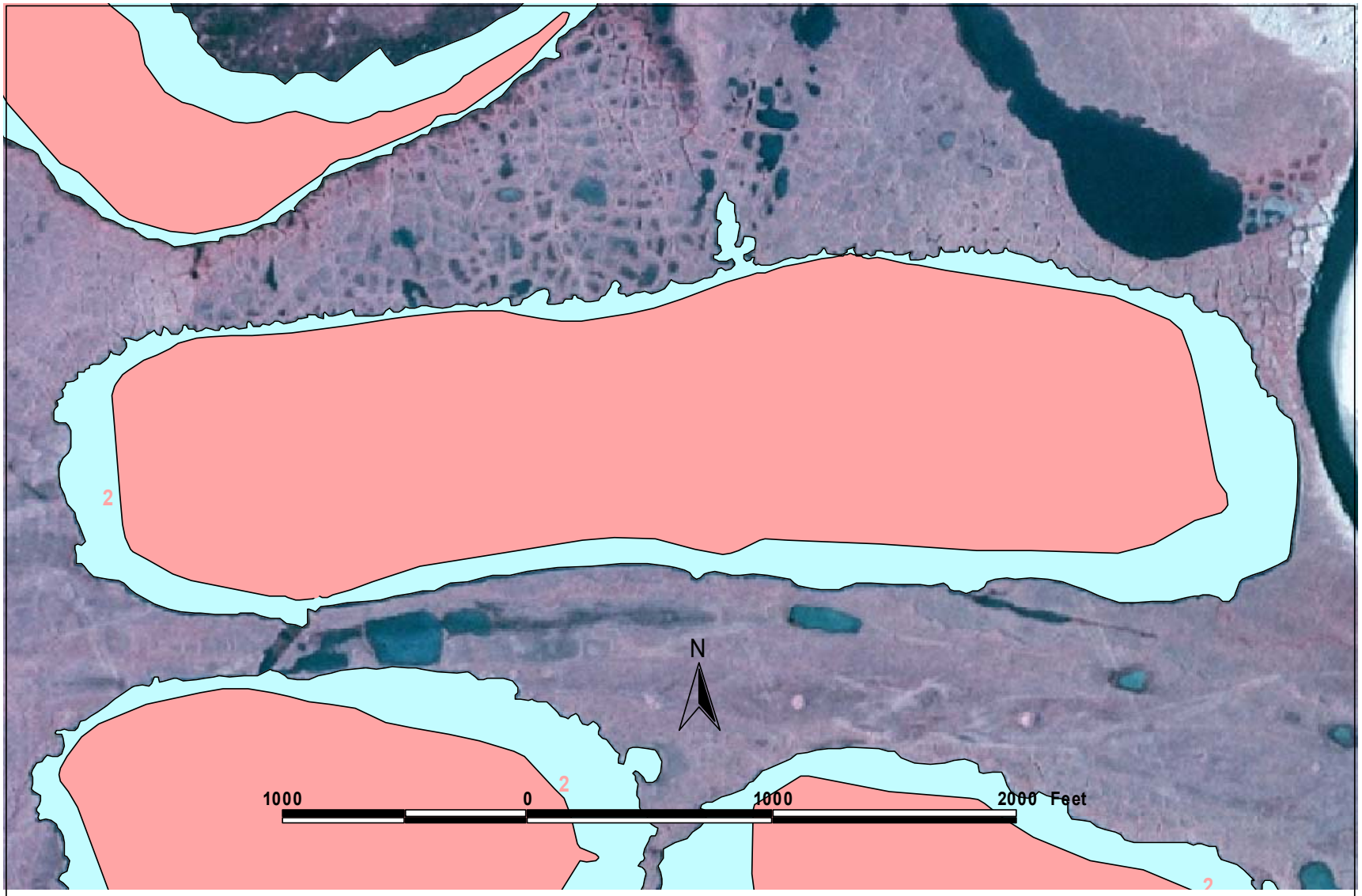
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
connected to M0526 and M0527, not fished on July 23, 2005				



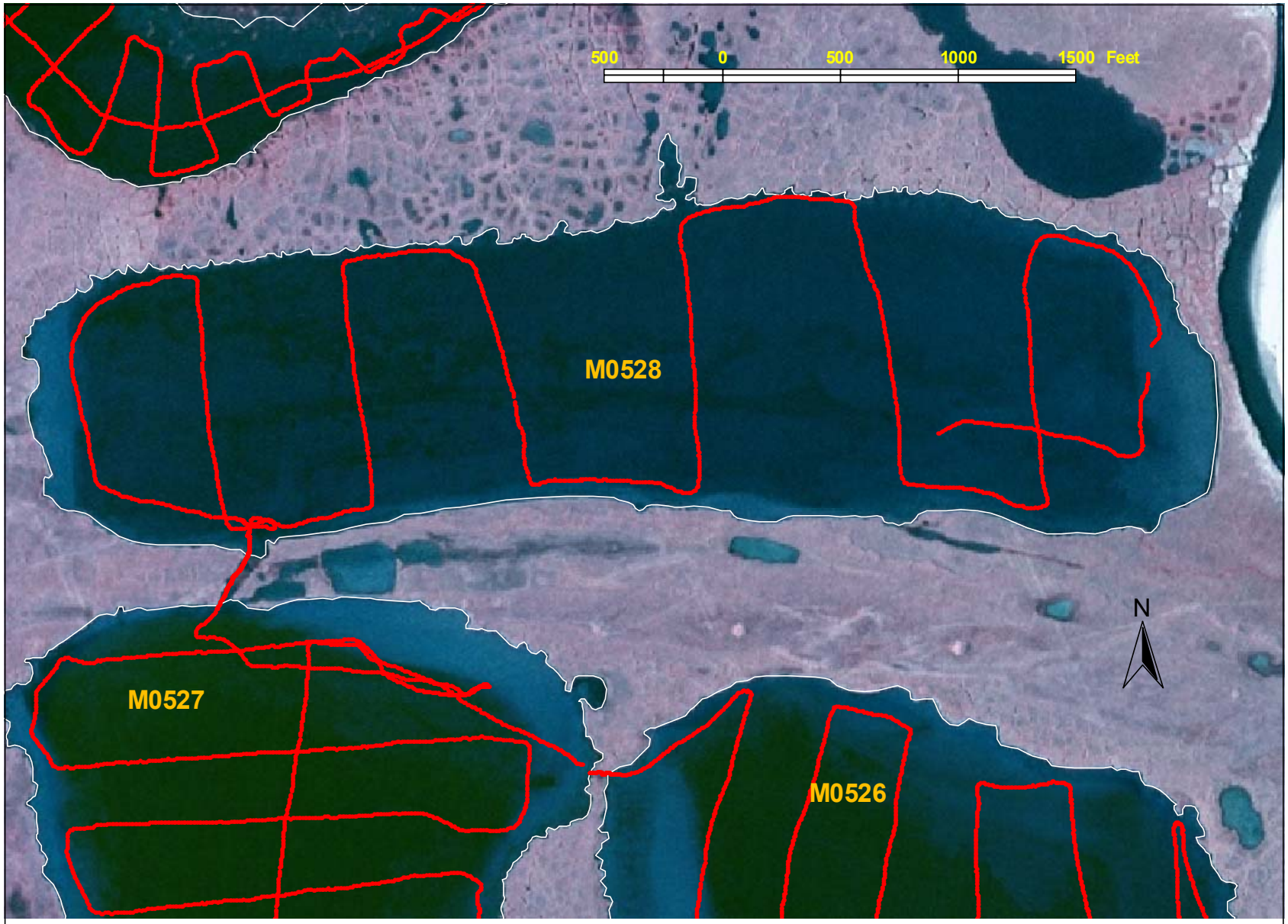
Depth contours of lake M0528 based on transects surveyed on July 23, 2005
(depths in 2 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)



Regions of lake M0528 less than 4 feet deep (light-shaded) and likely to available for ice chips, based on transects surveyed on July 23, 2005.

(not to be used for navigation or to direct use of heavy equipment)



Depth transects surveyed at lake M0528 on July 23, 2005.

Lake M0529

Other Names: Field identifier - CP0506
Location: 70.57044°N 155.13927°W
USGS Quad Sheet: Teshekpuk C-4: T14N R13W, Sec. 13
Area: 60.7 acres
Maximum Depth: 12.3 feet
Active Outlet: Yes
Total Lake Volume: 91.9 million gallons (July 24, 2005 data)
Water Volume Under 4 ft of ice: 35.7 million gallons
Water Volume Under 5 ft of ice: 25.5 million gallons
Water Volume Under 7 ft of ice: 8.7 million gallons
Potential Ice Aggregate: 28.2 acres (water depth 4 ft or less)

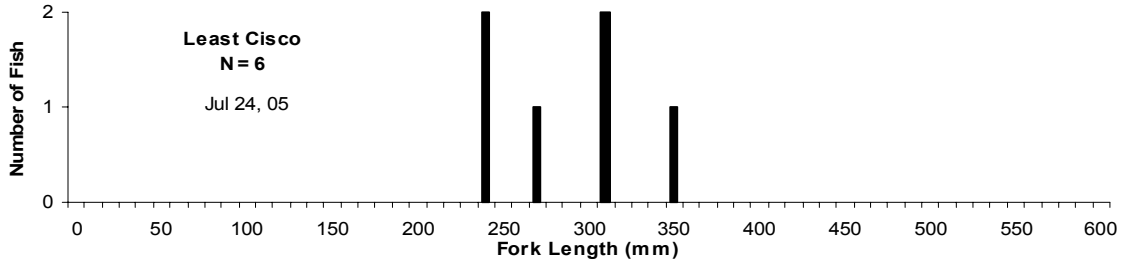
Maximum Recommended Winter Removal: **1.30 million gallons**
(15% of water volume under 7 ft of ice)
(does not include volumes related to ice chips)

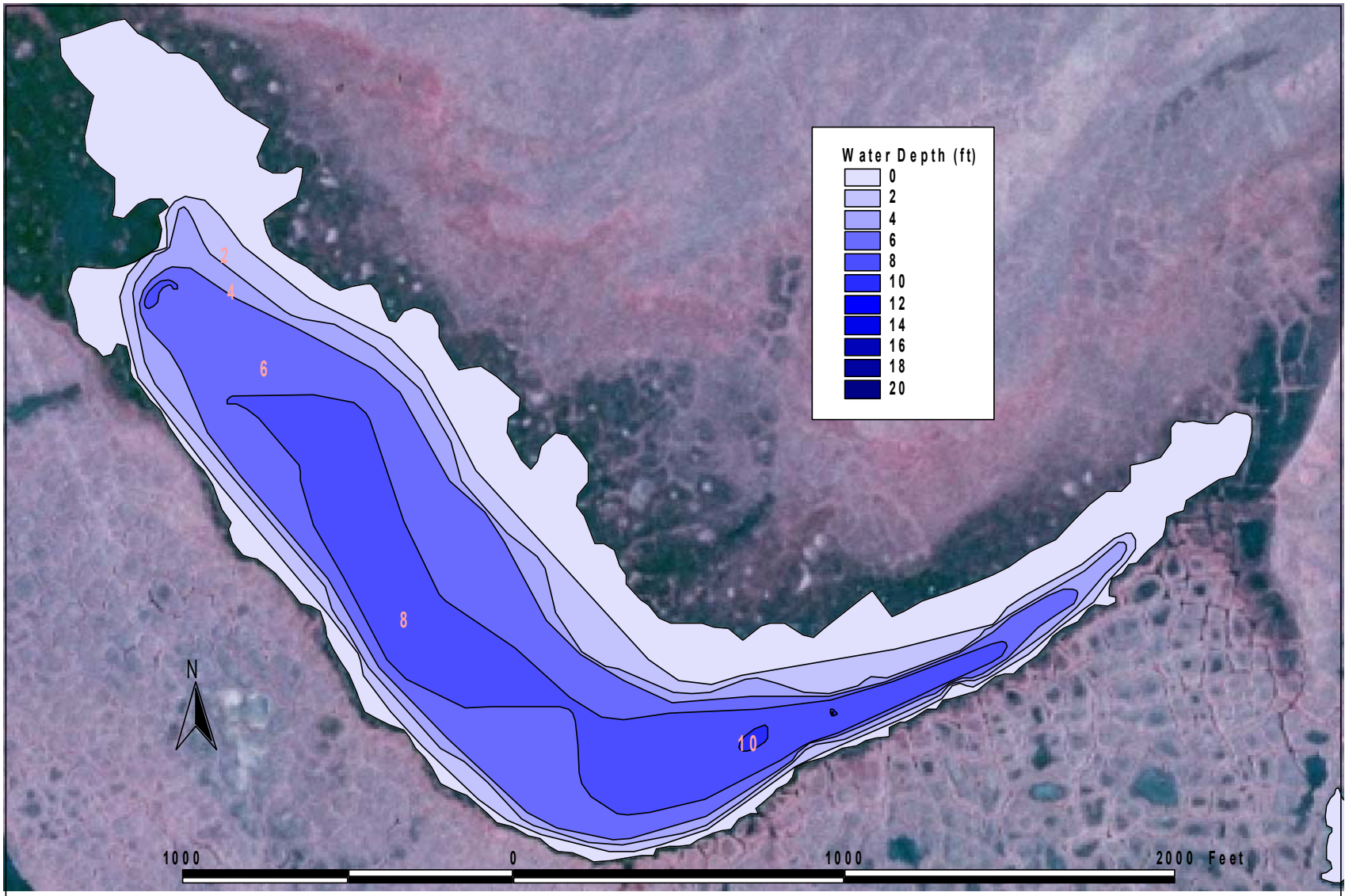
Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2005	12.0	2.2	3.0	<3	39	80	0.7	8.01	This Study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 24 05	0.7	Least cisco	6	248-353



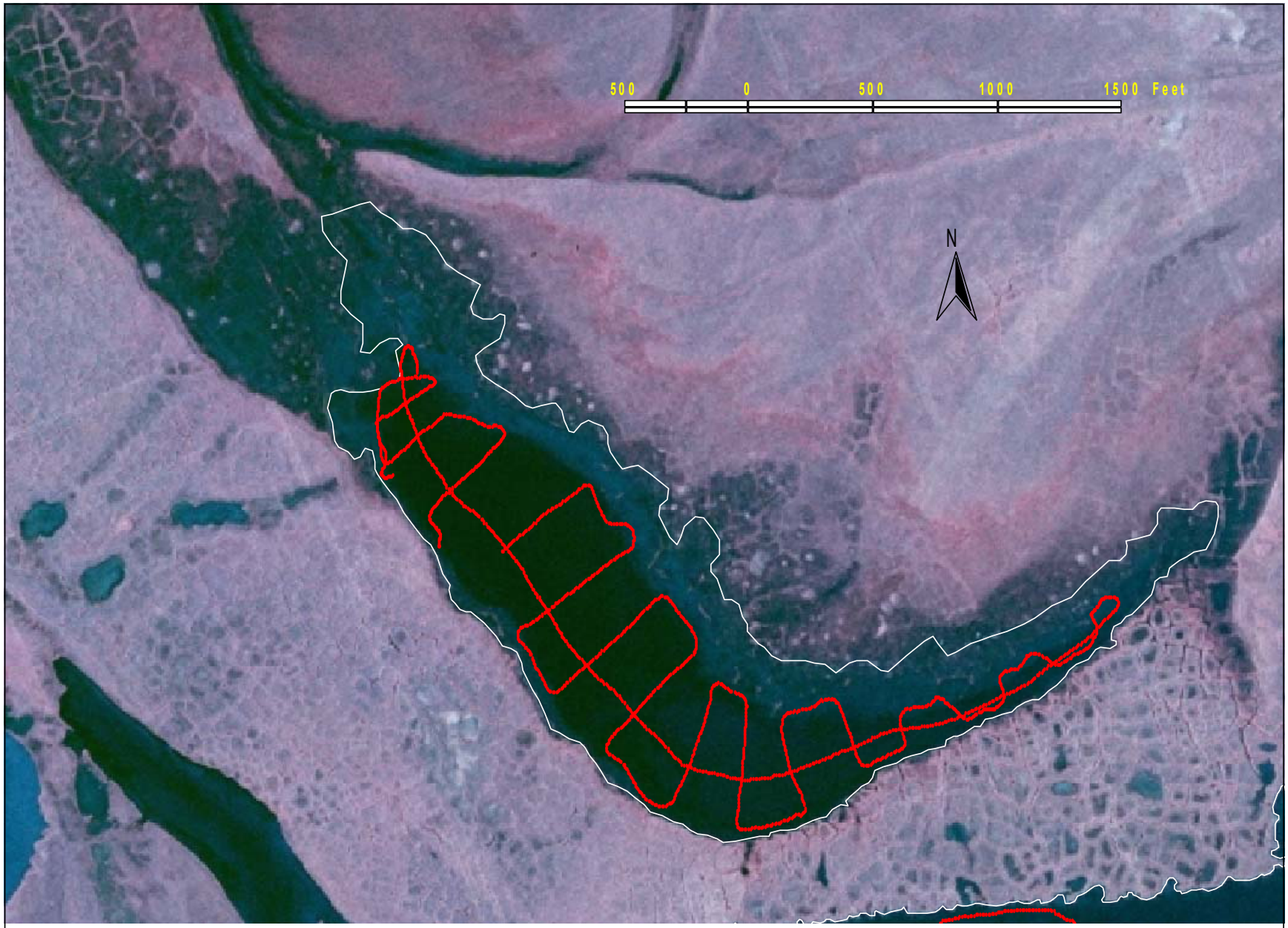


Depth contours of lake M0529 based on transects surveyed on July 24, 2005
(depths in 2 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Regions of lake M0529 less than 4 feet deep (light-shaded) and likely to available for ice chips, based on transects surveyed on July 24, 2005.

(not to be used for navigation or to direct use of heavy equipment)



Depth transects surveyed at lake M0529 on July 24, 2005.

Lake M0530

Other Names: Field identifier - CP0511
Location: 70.55891°N 155.16475°W
USGS Quad Sheet: Teshekpuk C-4: T14N R13W, Sec. 14/23
Area: 36.3 acres
Maximum Depth: 20.1 feet
Active Outlet: No
Total Lake Volume: 147.5 million gallons (July 24, 2005 data)
Water Volume Under 4 ft of ice: 102.6 million gallons
Water Volume Under 5 ft of ice: 92.0 million gallons
Water Volume Under 7 ft of ice: 71.6 million gallons
Potential Ice Aggregate: 3.3 acres (water depth 4 ft or less)

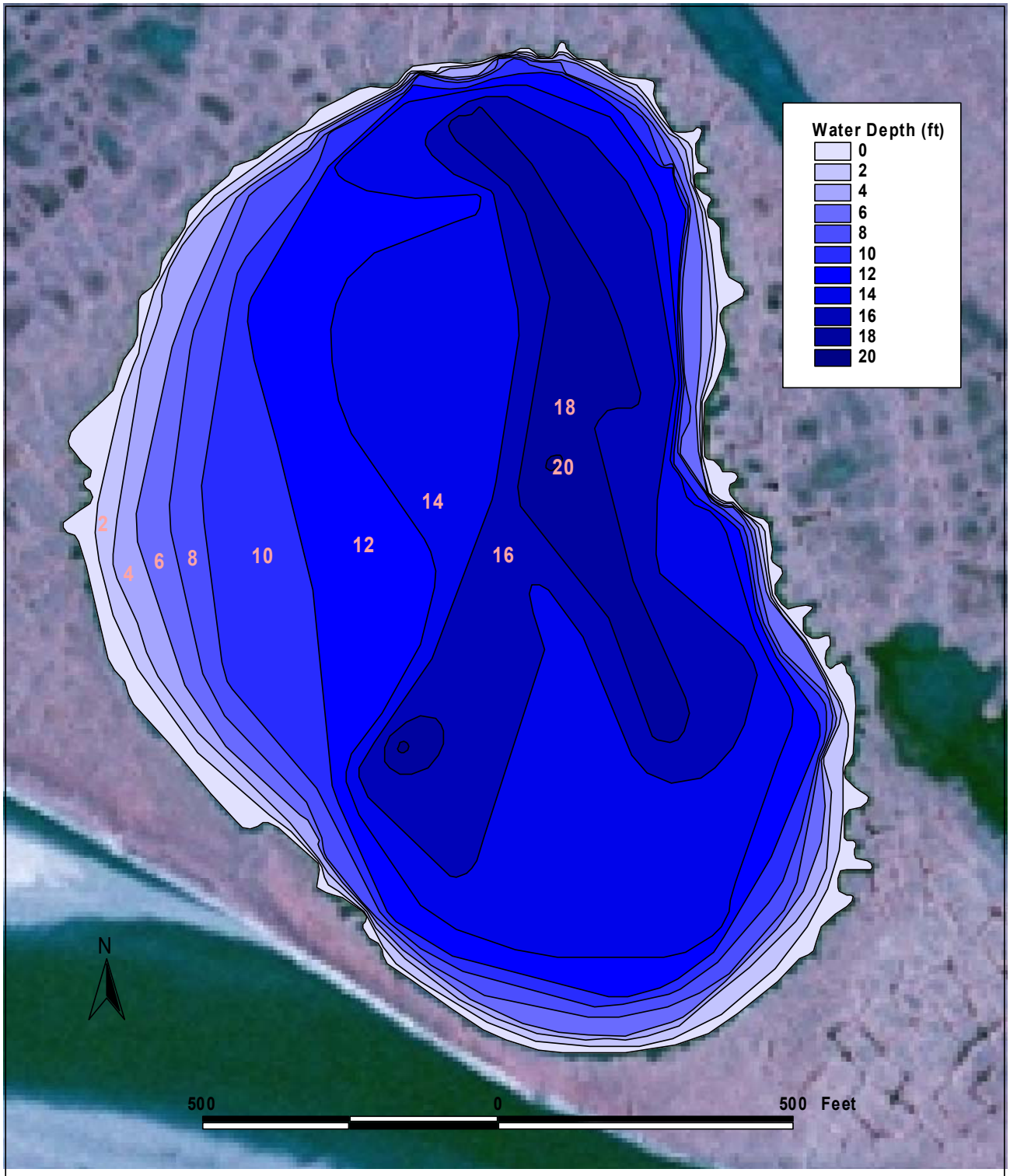
Maximum Recommended Winter Removal: **10.74 million gallons**
(15% of water volume under 7 ft of ice)
(does not include volumes related to ice chips)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2005	36.0	6.3	7.8	3.7	120	223	0.7	7.98	This Study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 24 05	0.7	Least cisco	1	395



Depth contours of lake M0530 based on transects surveyed on July 24, 2005
(depths in 2 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Regions of lake M0530 less than 4 feet deep (light-shaded) and likely to available for ice chips, based on transects surveyed on July 24, 2005.

(not to be used for navigation or to direct use of heavy equipment)

Depth transects surveyed at lake M0530 on July 24, 2005.

Lake M0531

Other Names: Field identifier - CP0505
Location: 70.57508°N 155.17494°W
USGS Quad Sheet: Teshekpuk C-4: T14N R13W, Sec. 11/14
Area: 72.8 acres
Maximum Depth: 11.7 feet
Active Outlet: No
Total Lake Volume: 128.8 million gallons (July 24, 2005 data)
Water Volume Under 4 ft of ice: 53.5 million gallons
Water Volume Under 5 ft of ice: 38.8 million gallons
Water Volume Under 7 ft of ice: 15.1 million gallons
Potential Ice Aggregate: 25.5 acres (water depth 4 ft or less)

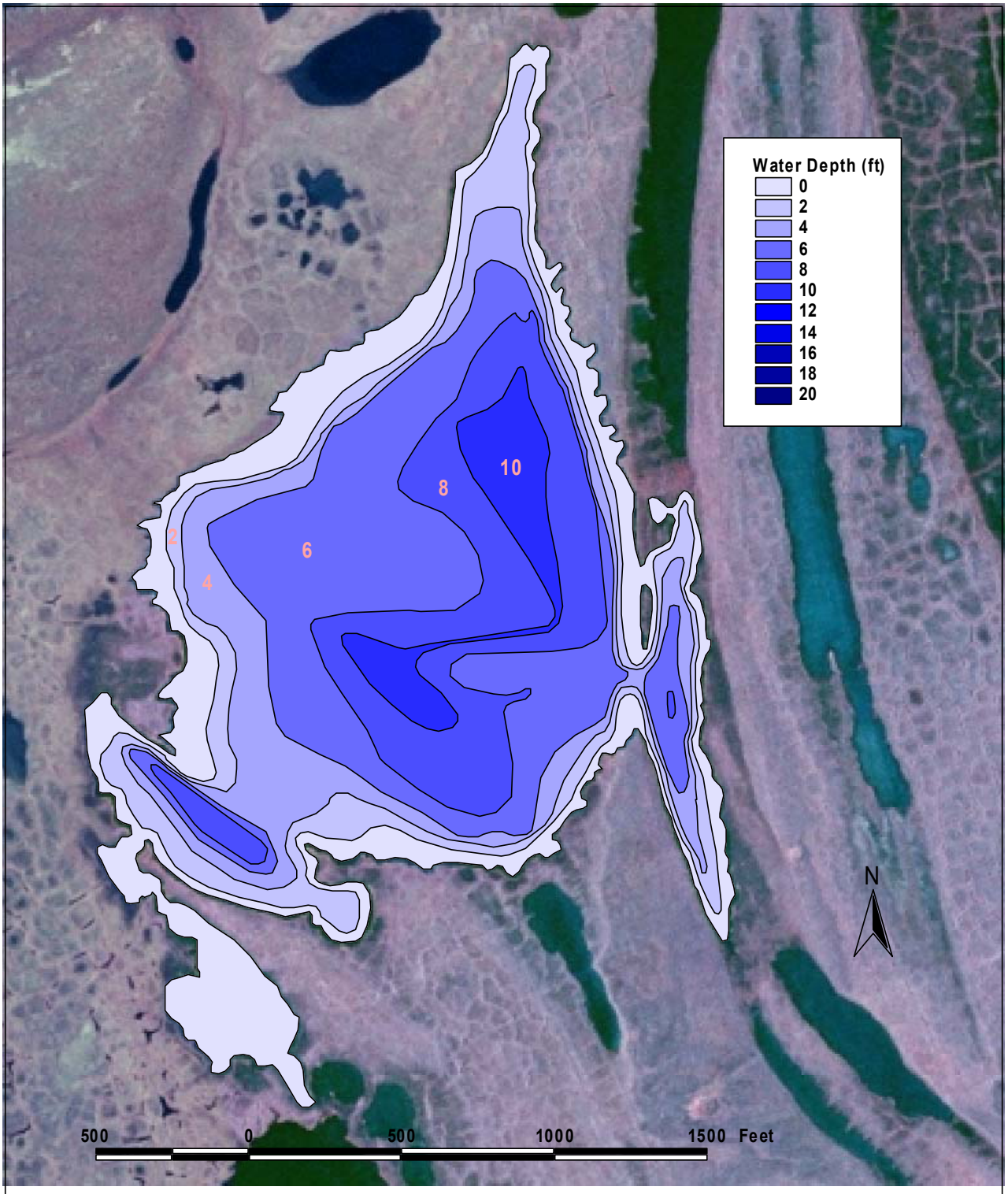
Maximum Recommended Winter Removal: **2.27 million gallons**
(15% of water volume under 7 ft of ice)
(does not include volumes related to ice chips)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2005	22.0	4.6	7.5	3.9	74	154	0.5	7.45	This Study

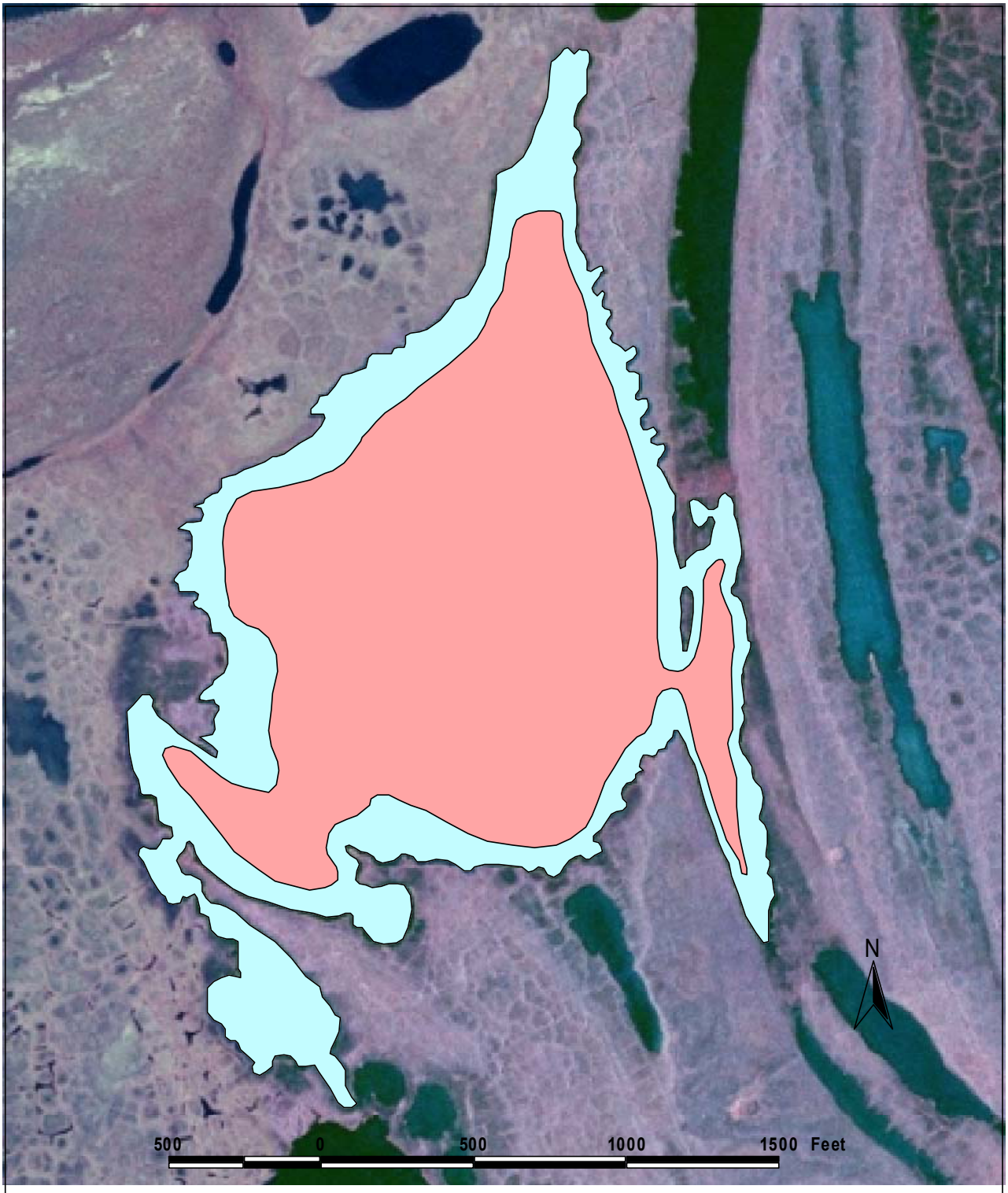
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 24 05	6.0	Least cisco	1	328
Minnow traps	Jul 24 05	67.3	Ninespine stickleback	52	



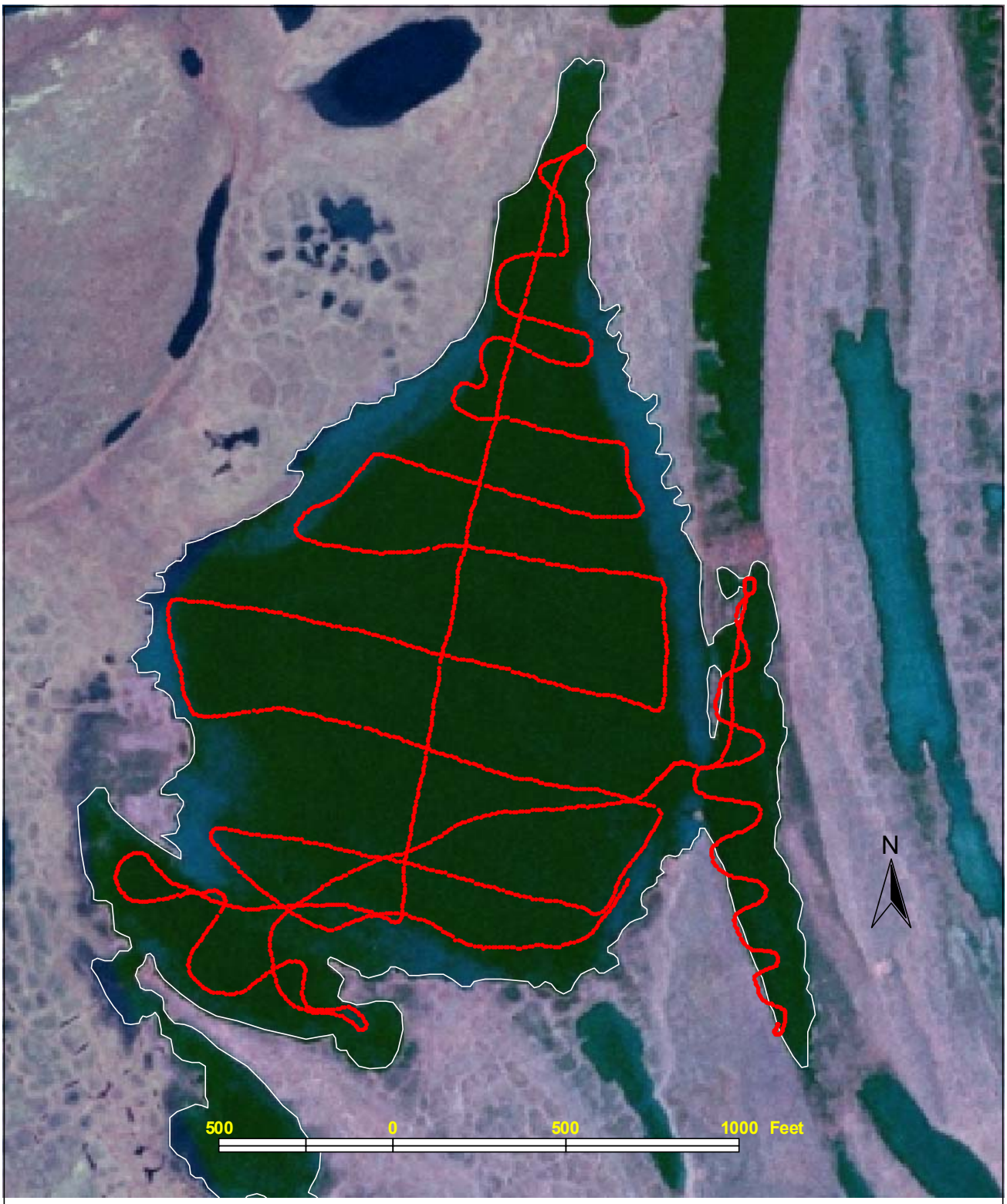
Depth contours of lake M0531 based on transects surveyed on July 24, 2005
(depths in 2 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)



Regions of lake M0531 less than 4 feet deep (light-shaded) and likely to available for ice chips, based on transects surveyed on July 24, 2005.

(not to be used for navigation or to direct use of heavy equipment)



Depth transects surveyed at lake M0531 on July 24, 2005.

Lake M0532

Other Names: Field identifier - CP0503
Location: 70.58892°N 155.23266°W
USGS Quad Sheet: Teshekpuk C-4: T14N R13W, Sec. 3/4/9/10
Area: 51.8 acres
Maximum Depth: 13.1 feet
Active Outlet: No
Total Lake Volume: 58.0 million gallons (July 24, 2005 data)
Water Volume Under 4 ft of ice: 15.2 million gallons
Water Volume Under 5 ft of ice: 10.7 million gallons
Water Volume Under 7 ft of ice: 4.4 million gallons
Potential Ice Aggregate: 36.6 acres (water depth 4 ft or less)

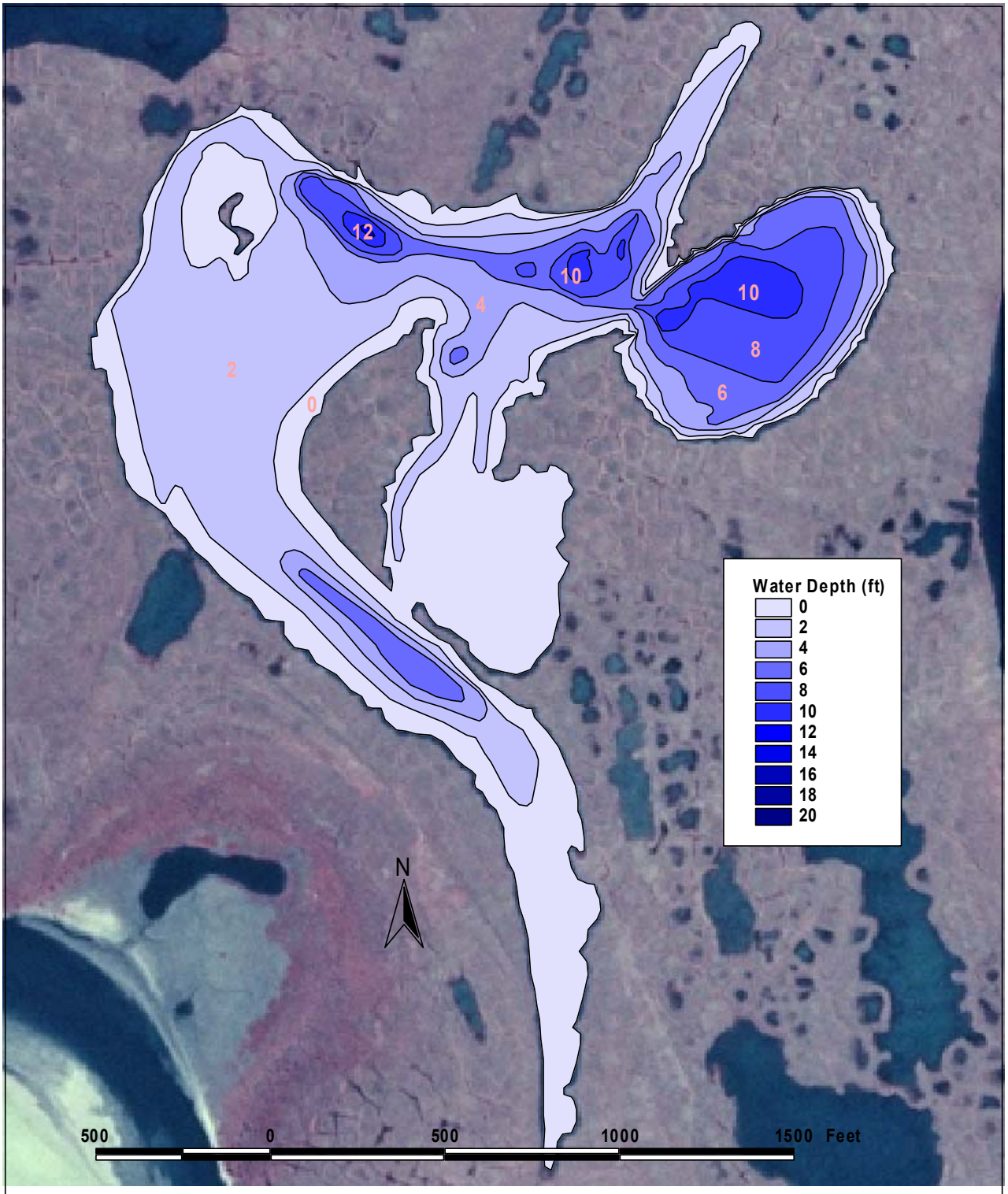
Maximum Recommended Winter Removal: **15.22 million gallons**
(water volume under 4 ft of ice)
(does not include volumes related to ice chips)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2005	33.0	9.6	14.2	5.8	120	247	0.4	7.76	This Study

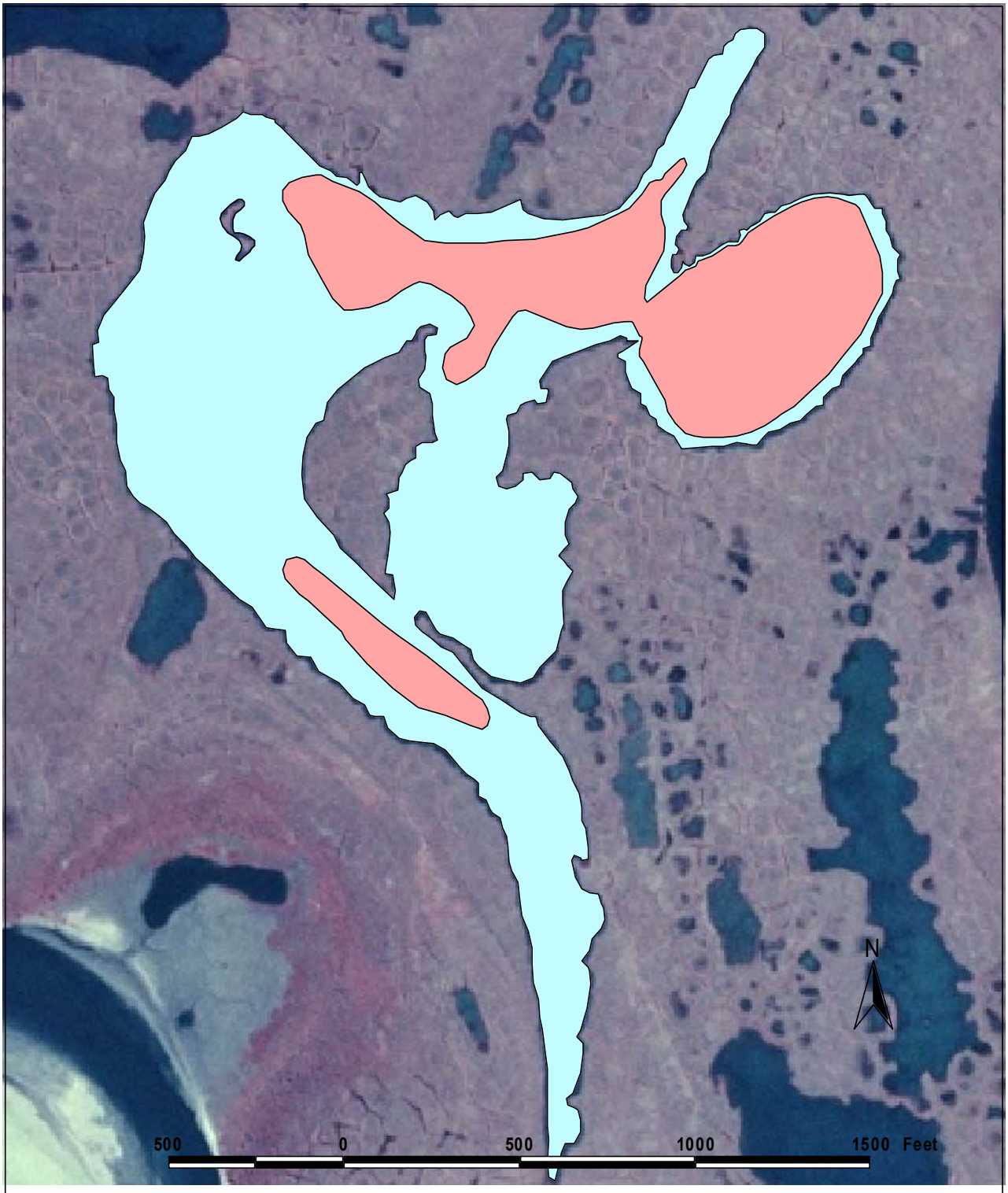
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 24 05	4.1	None	0
Minnow traps	Jul 24 05	17.4	None	0



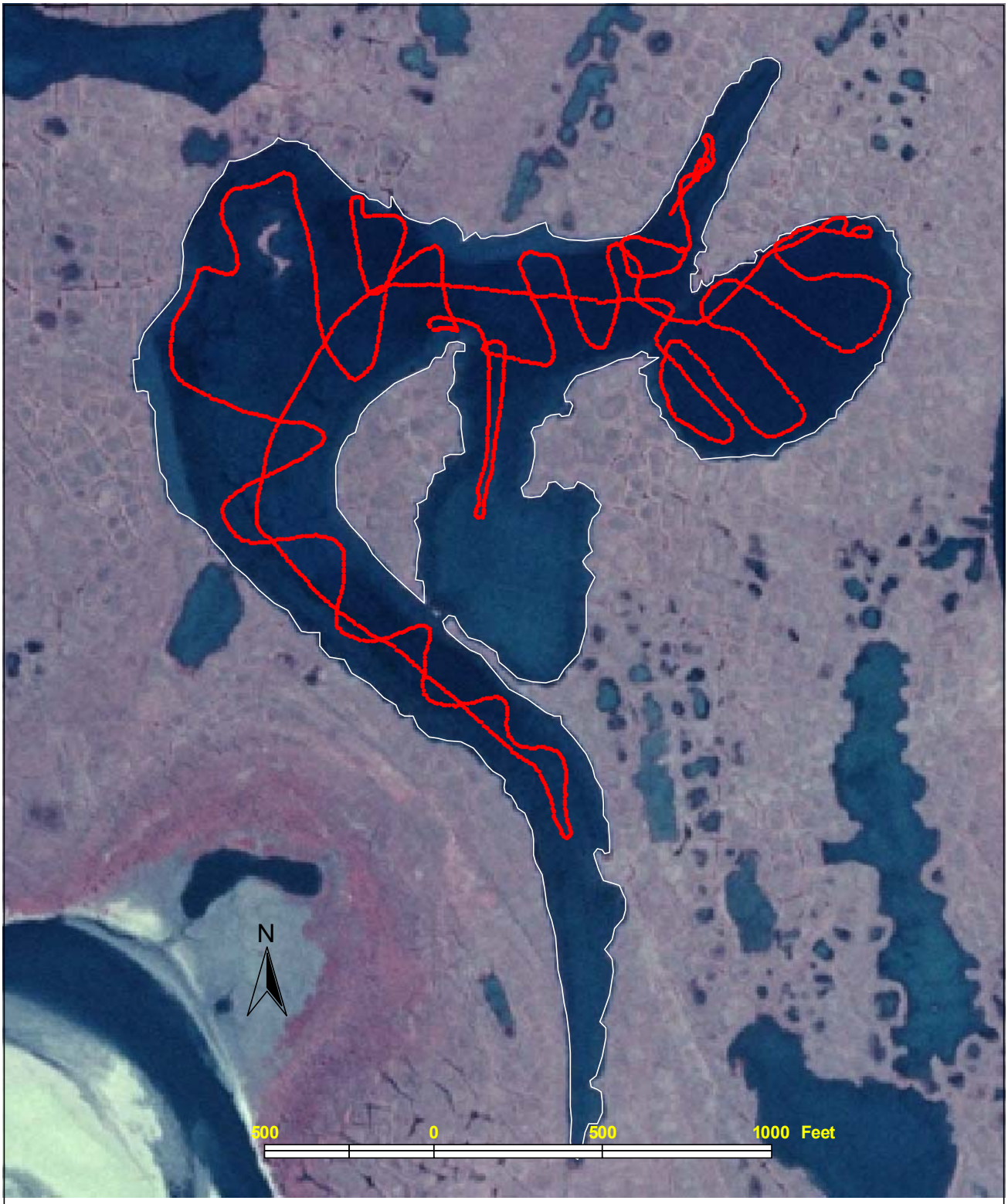
Depth contours of lake M0532 based on transects surveyed on July 24, 2005
(depths in 2 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)



Regions of lake M0532 less than 4 feet deep (light-shaded) and likely to available for ice chips, based on transects surveyed on July 24, 2005.

(not to be used for navigation or to direct use of heavy equipment)



Depth transects surveyed at lake M0532 on July 24, 2005.

Lake M0533

Other Names: Field identifier - CP0501
Location: 70.59798°N 155.23240°W
USGS Quad Sheet: Teshekpuk C-4: T14N R13W, Sec. 3/4
Area: 61.9 acres
Maximum Depth: 14.8 feet
Active Outlet: Yes
Total Lake Volume: 176.2 million gallons (July 23, 2005 data)
Water Volume Under 4 ft of ice: 103.6 million gallons
Water Volume Under 5 ft of ice: 87.1 million gallons
Water Volume Under 7 ft of ice: 56.2 million gallons
Potential Ice Aggregate: 10.3 acres (water depth 4 ft or less)

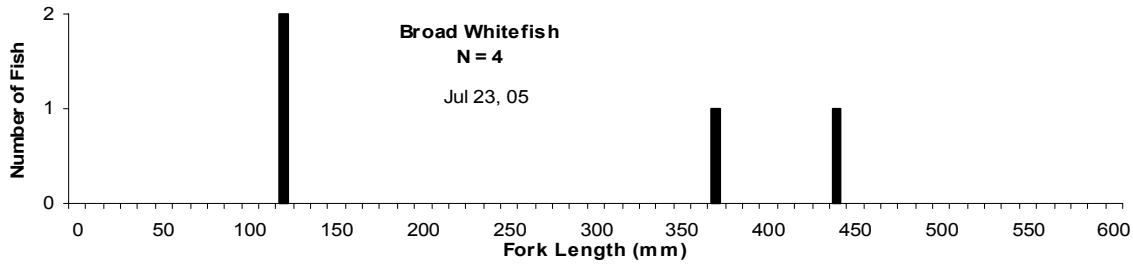
Maximum Recommended Winter Removal: **8.42 million gallons**
(15% of water volume under 7 ft of ice)
(does not include volumes related to ice chips)

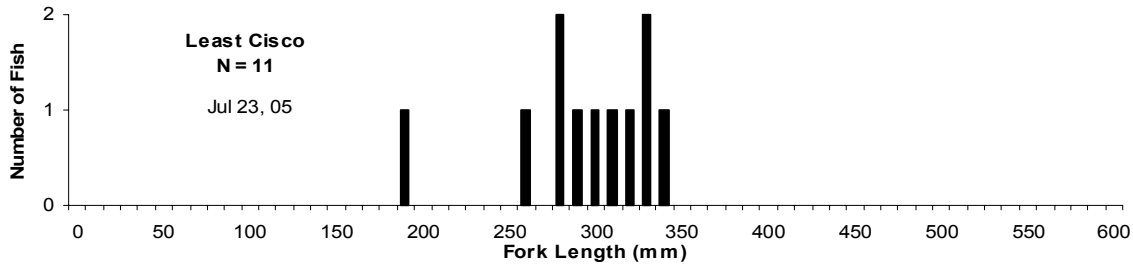
Water Chemistry:

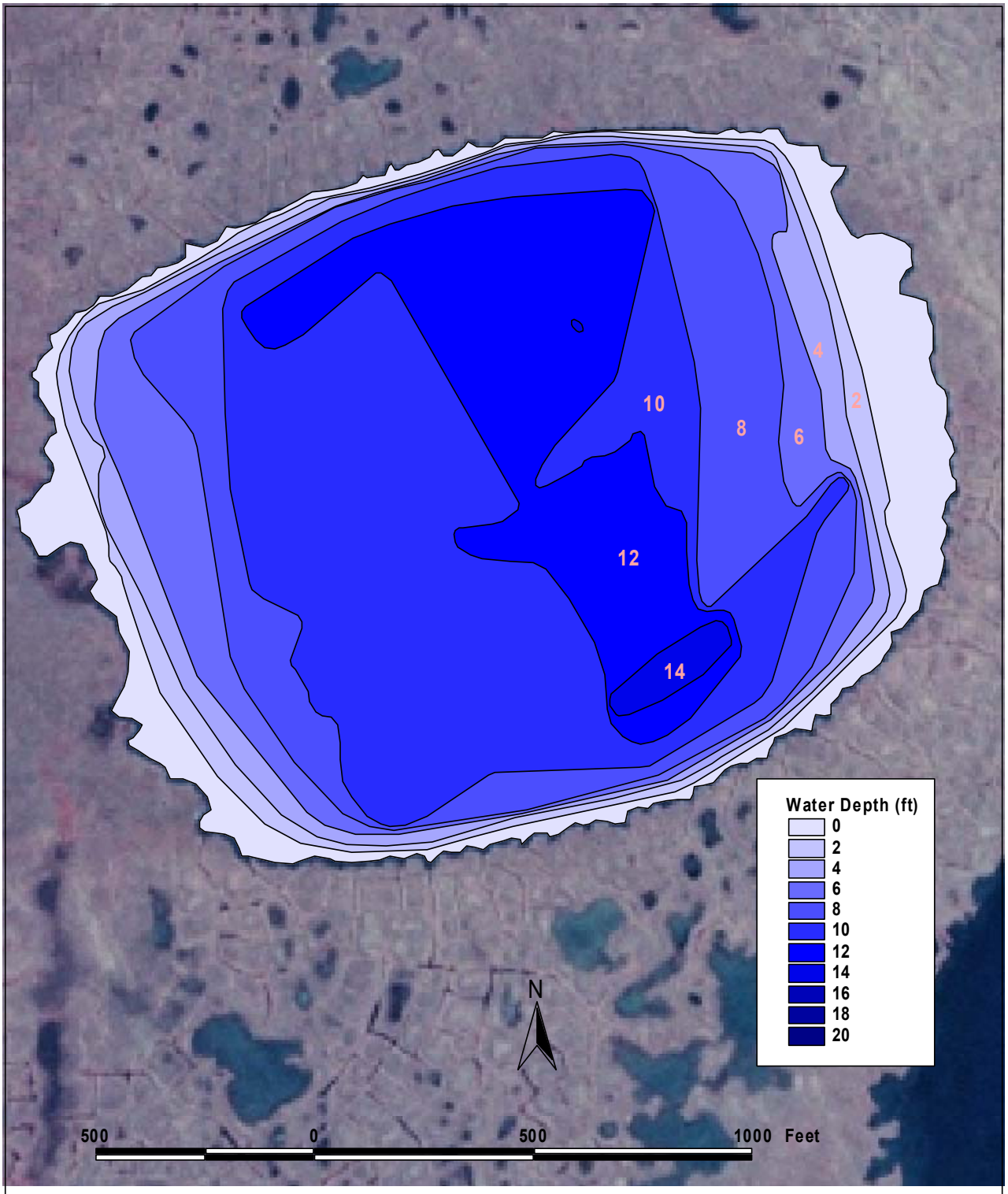
Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2005	17.0	3.1	4.3	<3	55	111	1.0	7.38	This Study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 23 05	1.6	Broad whitefish	4	120-440
			Least cisco	11	196-340
Minnow Trap	Jul 23 05	7.6	Alaska blackfish	1	50
			Ninespine stickleback	1	

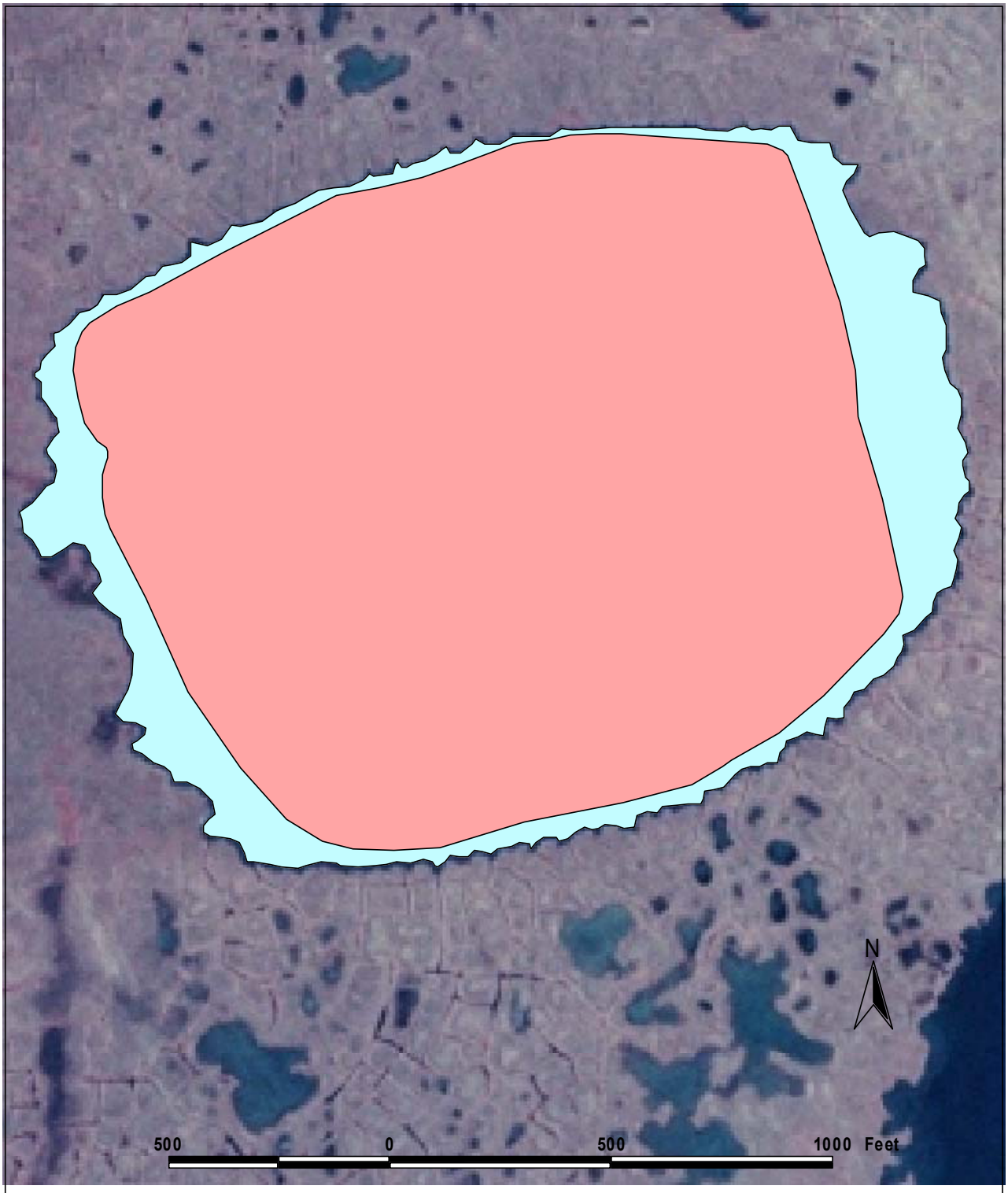






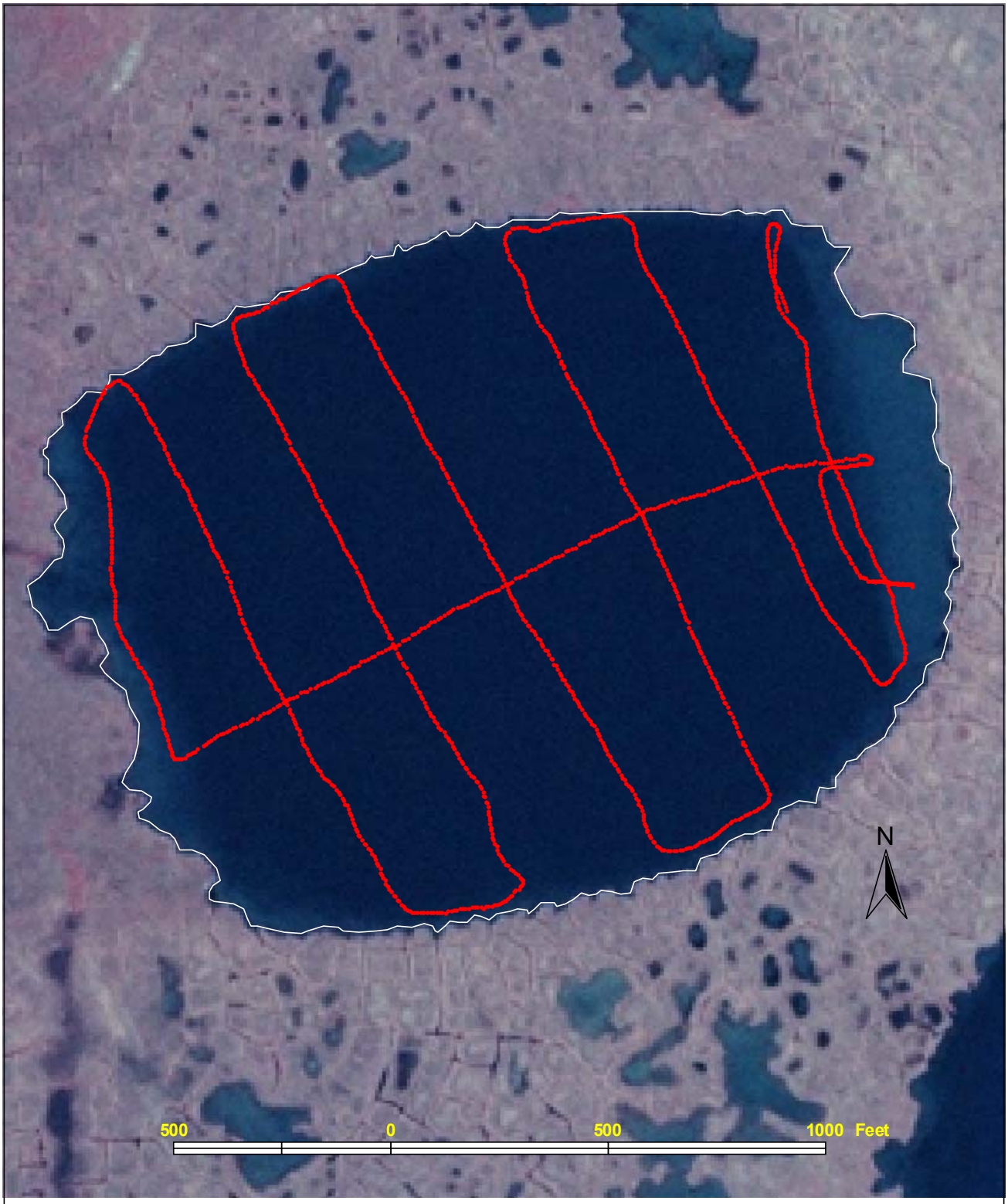
Depth contours of lake M0533 based on transects surveyed on July 24, 2005
(depths in 2 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)



Regions of lake M0533 less than 4 feet deep (light-shaded) and likely to available for ice chips, based on transects surveyed on July 24, 2005.

(not to be used for navigation or to direct use of heavy equipment)



Depth transects surveyed at lake M0533 on July 24, 2005.